Engineering Library

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The Engineer.

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VOL. CXLVIII.—No. 3839] LONDON: FRIDAY EVENING, AUGUST 9, 1929 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Applications are Invited for APPOINTMENTS as :—
1. LECTURER in MECHANICAL ENGINEERING.
2. LECTURER in CIVIL ENGINEERING,
at the Government Technical Institute, Insein, Burma.

Candidates for (1) should possess an Honours Degree in Engineering and have had experience both in teaching and in engineering work. Preference will be given to an applicant with experience in the design, construction and working of Internal Combustion Engines.

Candidates for (2) should possess an Honours Degree in Engineering of a British University and have had experience in teaching and in the design and construction of Civil Engineering Works.

Conditions for either appointment :—

Salary Rs. 1050 a month, rising by annual increments of Rs. 50 to Rs. 1250 a month, equivalent approximately to £945 per annum, rising to £1125 per annum. Agreement for five years in first instance. Free first-class passage out and home. In the event of renewal of agreement one free return passage home will be granted. Provident Fund. Strict medical examination. Age preferably about 35 years.

Full particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 14th September, 1929. 2818

Civil Service Commission.
FORTHCOMING EXAMINATION.
PROBATIONARY INSPECTORS in the Engineering Department of the Post Office (17-23, with extension for service in H.M. Forces).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. The latest date for the receipt of application forms is 26th September. 2822

Civil Service Commission.
FORTHCOMING EXAMINATION.
PROBATIONARY ASSISTANT ENGINEERS in the Engineering Department of the Post Office (20-25, with extension in certain cases).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. The latest date for the receipt of application forms is 12th September. 2820

Crown Agents for the Colonies.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/1569.—ASSISTANT DISTRICT ENGINEER REQUIRED by the GOVERNMENT of CEYLON for the Railway Department for three years' service, with possible extension. Salary £450, rising to £690 a year by annual increments of £30. Candidates, preferably unmarried, between the ages of 26 and 31, should have passed Sections "A" and "B" of the examinations for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from these examinations. Should have had at least three years' suitable experience on railway construction or on maintenance work. Must be capable of assisting a District Engineer in charge of a district of about 200 miles, carrying on any or all the duties of the District Engineer if and as required. Should be capable of designing bridges, buildings and other structures with all calculations necessary for these works.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/1569. 2831

Department of Scientific and Industrial Research.

JUNIOR ASSISTANTS are REQUIRED at the NATIONAL PHYSICAL LABORATORY in the Metallurgy Department. Candidates should have a good Honours Degree, preferably with some research or technical experience in metallurgy.

Scale of salary £175-15-£235 per annum plus Civil Service bonus ; the total pay corresponding to £175 basic is at present approximately £266. Superannuation provision will be made under the Federated Superannuation System for Universities.—Application must be made on a form to be obtained from the DIRECTOR, National Physical Laboratory, Teddington, to whom it should be returned not later than August 31st, 1929. 2821

University of Manchester.
FACULTY OF SCIENCE.
DEPARTMENT OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, lead to the University Degree in Civil, Mechanical and Electrical Engineering. Students who have shown exceptional ability during the first year are admitted to the Honours Courses. A prospectus giving full information may be obtained on application to the REGISTRAR.

THE SESSION COMMENCES ON THURSDAY, OCTOBER 3rd.

DEPARTMENTS.

Professor A. H. GIBSON, D.Sc., M. Inst. C.E., M.I. Mech. E. (Engineering).
Professor ROBERT BEATTIE, D.Sc. (Electrical Engineering).
Professor D. R. HARTREE, M.A., Ph.D. (Applied Mathematics).
Professor L. J. MORDELL, B.A., M.Sc., F.R.S. (Pure Mathematics).
Professor ARTHUR LAPWORTH, D.Sc., LL.D., F.R.S. (Chemistry).
Professor W. L. BRAGG, M.A., M.Sc., F.R.S., Nobel Laureate (Physics).
Professor F. C. THOMPSON, M.Sc., D.Met. (Metallurgy).
Professor O. T. JONES, M.A., D.Sc., F.R.S. (Geology). 2819

The Engineer

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PUBLIC NOTICES

UNIVERSITY OF LONDON.
King's College.
FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

POST-GRADUATE COURSES in CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING are also provided.

HEADS OF DEPARTMENTS :

Professor E. WILSON, M. Inst. C.E., M.I.E.E., Wh.Sch., Electrical Engineering (Dean).
Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering.
S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer in Electrical Engineering.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY King's College, Strand, W.C. 2. 2723

St. Helens Education Committee.

A FULL-TIME LECTURER in MECHANICAL ENGINEERING is REQUIRED for the St. Helens Municipal Technical School. Salary in accordance with the Burnham Scale.—Forms of application from the SECRETARY FOR EDUCATION, Education Office, St. Helens. 2766

PUBLIC NOTICES

University of Bristol.
FACULTY OF ENGINEERING.
(Provided and Maintained by the MERCHANT VENTURERS' TECHNICAL COLLEGE).
VICE-CHANCELLOR : T. LOVEDAY, M.A., LL.D.
DEAN OF THE FACULTY : ANDREW ROBERTSON, D.Sc., M.I. Mech. E., M. Inst. C.E.
DEPARTMENTS.
CIVIL ENGINEERING.—Prof. A. J. SUTTON PIPPARD, M.B.E., D.Sc., M. Inst. C.E., M.I. Mech. E., F.R.Ae.S.
MECHANICAL ENGINEERING.—The DEAN.
ELECTRICAL ENGINEERING.—Prof. DAVID ROBERTSON, D.Sc., M.I.E.E.
AUTOMOBILE ENGINEERING.—Prof. W. MORGAN, B.Sc., M.I.A.E.
MATHEMATICS.—Prof. E. S. BOULTON, M.A., B.Sc.
GEOLOGY.—Prof. S. H. REYNOLDS, M.A., Sc.D.
CHEMISTRY.—Prof. F. FRANCIS, D.Sc., Ph.D., F.I.C.

Complete courses of study extending over three years, leading to the University Degree or Diploma in Civil, Mechanical, Electrical or Automobile Engineering.

A Sandwich Scheme of training extending over five years may be adopted by selected students.

Full particulars of courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.

The SESSION 1929/30 COMMENCES on OCTOBER 4th. 2724

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENT.

I.—MECHANICAL ENGINEERING.
"Chance" Professor : F. W. BURSTALL, M.Sc., M.A. (Cantab.), M.I. Mech. E.
II.—CIVIL ENGINEERING (AND TOWN PLANNING).
"Beale" Professor : CYRIL BATHO, M.Sc., D.Sc. (McGill), B.Eng., A.M. Inst. C.E.
III.—ELECTRICAL ENGINEERING.
Professor : WM. CRAMP, D.Sc., M.I.E.E.

THE FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after Matriculation and pass successfully the examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE IN ENGINEERING.

THE SESSION 1929-30 COMMENCES ON 30th SEPTEMBER, 1929.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 2719

PUBLIC NOTICES

University of Birmingham.
DEPARTMENT OF METALLURGY.

"Feeney" Professor : D. HANSON, D.Sc.

The course of study covers three years and leads to the Degree of B.Sc. in Metallurgy. There is also an Honours School. Special attention is devoted to iron and steel, copper, brass, metallography, the needs of local industries and to preparation for colonial and foreign posts.

THE SESSION 1929-30 COMMENCES ON 30th SEPTEMBER, 1929.

Research and other Scholarships.

For detailed syllabus apply to the REGISTRAR. 2720

University College of Swansea.
(A Constituent College of the University of Wales.)
APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.
Professor : FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering : R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering : A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer : J. SELWYN CASWELL, A.M.I. Mech. E.

METALLURGY.
Professor : C. A. EDWARDS, D.Sc. (Manchester).
Assistant Professor : L. TAVERNER, A.R.S.M.
Lecturer : L. B. PFEIL, D.Sc. (Lond.), A.R.S.M.
Assistant Lecturers : J. C. JONES, M.Sc. (Wales).
R. GRIFFITHS, B.Sc. (Wales).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to Works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering ; (B) Mechanical Engineering ; (C) Electrical Engineering ; (D) Metallurgy ; and (2) for Diplomas of the College in (A) Civil Engineering ; (B) Mechanical Engineering ; (C) Electrical Engineering ; (D) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in September, 1929.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW, Registrar.
Singleton Park, Swansea. 2480

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for :—

506 STEEL BOILER TUBES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Friday, 2nd August, 1929.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Tuesday, 13th August, 1929.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS, Secretary.
2805

NORTHERN INDIA
ENGINEERING DEVELOPMENT.

Many huge projects are completed, others are under construction, and still more are under consideration. When tendering, remember that we have handled, inter alia, all the material for the Lloyd Barrage, the largest irrigation scheme in the world, and that WE HAVE THE EXPERIENCE to enable us to quote you the most favourable terms for CLEARING and DESPATCHING up country any quantity of material to any site required.

For full particulars apply, EASTERN EXPRESS CO., Ltd., Karachi ; or to Messrs. FORBES, FORBES, CAMPBELL and CO., Ltd. (Managing Agents), 9, King William-street, London, E.C. 4. F 5899

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PUBLIC NOTICES

The Royal Technical College, GLASGOW.

DEPARTMENTS OF ENGINEERING.

MECHANICS AND MECHANICAL ENGINEERING: Professor Alexander L. Mellanby, D.Sc., M.I. Mech. E.
Associate Professor William Kerr, Ph.D., A.R.T.C., M.I. Mech. E.
ELECTRICAL ENGINEERING: Professor Stanley Parker Smith, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING: Professor George Moncur, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING: Professor Daniel Burns, M. Inst. M.E.
CHEMICAL ENGINEERING: Professor of Technical Chemistry: Thomas Gray, D.Sc., LL.D., Ph.D., F.I.C.

Complete courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.

Composition fee, 25 guineas per annum.

SESSION 1929-30 BEGINS on TUESDAY, SEPTEMBER 24th.

Calendar, by post, 2s., and prospectus, gratis, may be obtained on application to the SECRETARY.

2491

BRIDGE COMPETITION.

The Harbour Board of the City

of Stockholm hereby invites to take part in a PUBLIC INTERNATIONAL COMPETITION for DESIGNS for a ROAD BRIDGE over Lake Mälaren, in Stockholm.

The programme documents can be obtained from the REGISTRAT of the HARBOUR BOARD, Katarinavägen 13a, against a deposit of 50 crowns, which amount will be repaid either after a proposal in accordance with the programme has been handed in, or if all the programme documents are returned undamaged before 1st October, 1929.

A grant of 50,000 Swedish Crowns has been appropriated to the competition, of which amount 38,000 Cr. is intended for at least three prizes, of which the lowest is to be not less than 5000 Cr. and 12,000 Cr. is intended for the purchase of designs submitted but not awarded a prize, the purchase money for single design being not less than 2000 Cr.

The period for the competition expires on 1st February, 1930. 2765

Borough of Bexhill.

VERTICAL BOILER, DISINFECTOR STATION, CLINCH GREEN, BEXHILL.

TENDERS are INVITED from recognised makers of Disinfector Plant for REMOVING an existing BOILER and SUPPLYING and ERECTING a NEW VERTICAL BOILER at the Disinfector Station, Clinch Green, Bexhill.

Specification and form of Tender may be obtained on application to the Borough Surveyor, Mr. Wm. Pearce, Assoc. M. Inst. C.E., Town Hall, Bexhill.

Tenders, endorsed "Vertical Boiler, Disinfector Station," should be received by the undersigned not later than Noon on Wednesday, 21st August, 1929.

The Council does not bind itself to accept the lowest or any Tender.

S. J. TAYLOR, Town Clerk.

Town Hall, Bexhill-on-Sea, 7th August, 1929. 2835

City of Birmingham.

ELECTRIC SUPPLY DEPARTMENT. MACHINE TOOLS AND WORKSHOP EQUIPMENT—HAMS HALL STATION.

The Electric Supply Department of the Birmingham Corporation invite TENDERS for the SUPPLY, DELIVERY and ERECTION of MACHINE TOOLS and WORKSHOP EQUIPMENT, required for the Engineering Workshop at the Hams Hall Power Station.

Specifications, drawings, conditions of contract and forms of Tender may be obtained on application to the undersigned.

Tenders, which must be under a sealed cover and endorsed "Tender for Machine Tools," to be addressed to the undersigned and delivered not later than Twelve Noon on the 28th August, 1929.

E. J. JENNINGS, Secretary.

14, Dale End, Birmingham, 31st July, 1929. 2806

Liverpool Corporation Water-WORKS.

VYRNWY AQUEDUCT—THIRD INSTALMENT. CONTRACT NO. 12.

TO STEEL WATER TUBE MANUFACTURERS.

The Water Committee of the Liverpool Corporation are prepared to receive TENDERS from manufacturers for the SUPPLY of a STEEL TUBE of 42in. internal diameter, about 65ft. in length and weighing about 10 tons.

The plan may be inspected and copy of the specification and form of Tender obtained at the Water Engineer's Office, 55, Dale-street, Liverpool, upon payment of the sum of Two Guineas, which amount will be returned upon receipt of a bona fide Tender and return of the document and drawing issued.

Tenders are to be sent through the post in a sealed envelope, addressed to "The Town Clerk, Municipal Buildings, Liverpool," so as to be delivered not later than Twelve o'clock Noon on Monday, the 9th day of September, 1929.

The Water Committee do not bind themselves to accept the lowest or any other Tender.

WALTER MOON, Town Clerk.

Municipal Buildings, Liverpool, August, 1929. 2816

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

MADRAS IMPROVEMENTS — ELECTRIFICATION OF SUBURBAN SERVICES.

(1) ELECTRIC GOODS LOCOMOTIVES and BATTERY TENDERS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Electric Goods Locomotives and Battery Tenders," with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 20th September, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, Westminster, S.W. 1, 7th August, 1929. 2843

Gears

See large advertisement next week.

The Power Plant Co. Ltd.

WEST DRAYTON · MIDDLESEX

PUBLIC NOTICES

SHOOT, LONDON COUNTY COUNCIL DOWNHAM HOUSING ESTATE, CATFORD, S.E.

The London County Council is

prepared to consider OFFERS for FILLING with satisfactory material the DISUSED SAND PIT on this estate, situated near Bromley-road, from which there is suitable lorry access. The capacity of the pit is approximately 20,000 cubic yards. No refuse of a nature which is likely to cause a nuisance or annoyance to the occupiers of adjoining property will be allowed.

Further particulars may be obtained on application to the COUNCIL'S VALUER, Old County Hall, Spring-gardens, S.W. 1. 2801

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, CHEMIST OR ENGINEER OR CHEMICAL ENGINEER,

Having first-class experience in the manufacture of Silk by the Dry (so-called Acetate) Process.

Those having only experimental experience need not apply, as only a practical man is required who is capable (based on actual experience) of supervising a large plant.

Particulars should be given of the daily production of silk spun, and how many spinning machines installed or operated and how many spindles per machine, so as to give some indication of experience.

Salary £400 to £900 per annum or more, according to experience.

Write, Box A. 757, Willing's, 86, Strand, W.C. 2. 2746 A

WANTED, ENGINEER Who Has Been engaged in the Erection and Operation of CELLULOSE ACETATE PLANT.

Particulars required about size of plant.

High salary offered to the right man.

Write, Box C. 759, Willing's, 86, Strand, W.C. 2. 2745 A

WANTED on Large Housing Scheme near London, TWO ASSISTANT CIVIL ENGINEERS; must be experienced in all branches of Setting Out, Levelling, Measuring Up, and General Routine of Contractor's Office.—Reply, stating age, experience, and salary required, to Box 142, c.o. Brown's, 39, Tothill-street, S.W. 1. 2800 A

WANTED, WORKS MANAGER for Locomotive Works. Must be familiar with locomotive practice, workshop progress and costs.—Address, stating full particulars of age, qualifications and salary expected, 2813, The Engineer Office. 2813 A

AN Opportunity Occurs in an Engineering Works in London for an ambitious young MECHANICAL ENGINEER, age 30/35, with a North Country training, practical works experience and first-class technical qualifications, preferably in connection with light engineering work. Must be good organiser, able works planner and have ability to get jobs done. The post offered is a progressive one to the right man, and will entail much hard work.—Write, stating age, experience, and salary required, together with copies of two recent testimonials. No application will be considered if these details are omitted. Without the necessary qualifications, please do not waste our time. —Z.R. 811, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 2778 A

CHIEF RATE FIXER for Machining, Fitting and Tinsmithing in Aero-engine Factory. Must have had wide experience on best-class work. Permanent position to suitable man.—Address, giving fullest details of experience and stating age and salary required, 2804, The Engineer Office. 2804 A

INDIA.—TRAVELLING REPRESENTATIVE of proved selling ability REQUIRED by Calcutta Firm holding important agencies. Applicants must have had previous experience in Pneumatic Machinery, also a knowledge of Oil Engines, Pumping Plants, Machine Tools and Steels. Capable of advising, estimating and supervising erection if necessary. Salary equivalent in Rupees of £650 p.a., with expenses and commission. Single, age (about) 30; 4 years' agreement.—Write, giving full details of previous experience, with copies of testimonials, to "A. D.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 2833 A

LONDON STRUCTURAL ENGINEERS REQUIRE Detailing DRAUGHTSMEN. Previous experience in similar work essential. State age, salary required, and full particulars of experience. Permanent positions for suitable applicants.—Address, 2841, The Engineer Office. 2841 A

PETTERS LIMITED DESIRE to ENGAGE SELLING ENGINEER, to be attached to their London office. Sound technical knowledge and London experience essential. Written application only. All replies treated confidentially.—Write, H. S. A., c/o Petters Limited, 75b, Queen Victoria-street, E.C. 4. 2826 A

PRACTICAL ENGINEER REQUIRED, Experienced in Power-house Work, Coal-handling Plant, and Heavy Grinding Machinery; also in the Pneumatic Conveyance of Powdered Materials. State age, experience, and salary required.—Address, P6047, The Engineer Office. P6047 A

REQUIRED IMMEDIATELY for London Correspondence Institution, YOUNG MAN as TUTOR in Civil and Mechanical Subjects up to B.Sc. standard. Sound theoretical training and some practical experience essential. Permanent whole-time position.—Address, P6079, The Engineer Office. P6079 A

TECHNICAL MANAGER WANTED in an Old-established engineering works having sound practical experience in Sugar Machinery, both in the drawing-office and shops, as well as abroad.—Address, stating full details as to experience, age, and salary required, 2837, The Engineer Office. 2837 A

THE SERVICES are REQUIRED of an ENGINEER of the approximate age of 35 as ASSISTANT to the MANAGING DIRECTOR of a large industrial concern in this country. The applications of those who have had experience in iron and steel and kindred industries will receive special consideration, and all applications will be treated in the strictest confidence.—Replies in writing only to Messrs. LINKLATERS and PAINES, 2, Bond-court, Walbrook, E.C. 4. 2815 A

WORKSHOP MANAGER REQUIRED for Works in Ceylon employing about 200 hands. Must be expert in Machine Tools, capable of renovating and modernising present plant and increasing production. Good knowledge of small tools essential. Age 26/30, single. Four years' agreement. Salary about £500 p.a. with free passage.—Address, with copies only of testimonials, P6071, The Engineer Office. P6071 A

WANTED, ENGINEERING DRAUGHTSMAN, Experienced Mechanical Handling Plant and Structures. Initiative and sound technical training essential. District, North Midlands. State age, experience, and salary required.—Address, 2825, The Engineer Office. 2825 A

SITUATIONS OPEN (continued)

£1500 to £2000 p.a., According to Experience, for COMMERCIAL ENGINEER to take complete charge Government contracts for an old-established firm. Work comprises tendering, sub-contracting where necessary, erection on site and handing over after test the equipment and plant manufactured. Only applicants having sound electrical and mechanical experience should apply; preference will be given to those having Automatic Telephone experience.—Address in strict confidence, 2830, The Engineer Office. 2830 A

WANTED, First-class DRAUGHTSMAN, thoroughly accustomed to Hand Cranes, Overhead Runways and General Constructional Work.—Address, with full particulars, age, salary and experience, 2838, The Engineer Office. 2838 A

WANTED in London, Competent DRAUGHTSMAN, to make scheme drawings in connection with Conveying and Mechanical Handling Plants. Experienced men only need apply. State age, experience, and salary.—Address, 2729, The Engineer Office. 2729 A

WANTED, TWO or THREE First-class DRAUGHTSMEN, accustomed to the design of Structural Steel Work and construction of Water-tube Boilers. Applicants must have had experience.—Address in first instance, stating age, salary required, and qualifications, 2739, The Engineer Office. 2739 A

DRAUGHTSMAN, Preferably with Experience in detail and design of Hydraulic Work, Valves, &c. Salary £3 10s. to £4 per week.—Address in confidence, giving particulars of education, age, and experience, 2834, The Engineer Office. 2834 A

DRAUGHTSMAN (JUNIOR), with General Rubber Works experience, for Edinburgh district.—Address, giving full particulars experience, age and wage required, 2758, The Engineer Office. 2758 A

DRAUGHTSMAN, Mechanical - Electrical, with general experience of Electrical Apparatus.—Address, stating age, experience, and salary required, 2302, The Engineer Office. 2802 A

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British Airship Progress.

Good progress is being made with the British airships "R 100" and "R 101," and on Monday, July 29th, a beginning was made with the inflation of "R 101" with hydrogen gas at the works of the Airship Guarantee Company, Ltd., at Howden, Yorkshire. The complete filling of the gasbags will occupy, it is anticipated, about a month, after which shed trials will be made by the Air Ministry staff, which will be followed by flight trials. The "gassing" of "R 100," which is being built by the Air Ministry at Cardington, was begun a little over two weeks ago and will be completed some time in September, after which the shed and flight trials will take place. Later on, flights by "R 100" to Canada and "R 101" to Egypt and India under the Ministry's auspices are contemplated. The airships will carry 100 passengers and they have a designed maximum speed of 82 miles per hour with a cruising speed of over 70 miles per hour. Higher speeds are now proposed for airships which are in contemplation, and in the new Burney-Rolls-Royce design a cruising speed of 100 miles per hour is provided for. A new heavier than air machine, the Blackburn-Rolls-Royce flying boat, is designed for a speed of 130 miles per hour and will carry 50 passengers.

The Late Karl Auer von Welsbach.

On Sunday last, August 4th, the death took place, at the Castle Welsbach, Carinthia, of Karl Auer Ritter von Welsbach, the inventor of the incandescent gas mantle and a renowned research worker in the chemistry of the rare earths. Herr Welsbach, who was seventy years of age at the time of his death, was the son of Aloys Auer Ritter von Welsbach, who was for many years the head of the State printing works in Vienna, and was himself an inventor of many new devices used in the Austrian printing and paper-making industries. Karl Welsbach studied under Professor Bunsen in Heidelburg, and his later researches into the chemistry of the rare earths yielded discoveries of both scientific and industrial importance. He invented the incandescent gas mantle in 1885, and about five years later he formed the Auergesellschaft, a company which began to manufacture the Welsbach mantles and to develop the various Welsbach patents. This company, of which Herr Welsbach was the president, now employs over 4000 workers. In 1897 he invented the Osmium metal filament for incandescent electric lamps, and about six years later he introduced the ferro-cerium compound known as "Auer" metal, which is largely employed as the igniting element in pocket lighters. Ritter von Welsbach was a member of the Academies of Science in Vienna, Berlin and Stockholm, as well as numerous other scientific bodies. He was the recipient of honorary degrees from the Universities of Heidelburg and Graz, and received many honours both from his own country and abroad. He personally endowed a number of social and scientific institutions, besides carrying out important chemical research at his own Treibach works and his private laboratories at home. The death of a scientist with such international repute cannot fail to be widely regretted.

Proposed British Port Developments.

Some days ago a deputation from the Shipowners' Parliamentary Committee, under the leadership of Sir Norman Hill, the vice-chairman of that Committee, waited upon Mr. J. H. Thomas, the Lord Privy Seal, to urge the need of Government assistance in connection with port development. A report of this interview has since been published. Sir Norman pointed out that whereas the world's tonnage had increased from forty-seven million tons before the war to the present figure of sixty-seven million tons, there had been little increase in the world's overseas trade, and the volume of overseas trade of this country had, in fact, decreased. Much of our mercantile fleet was under-employed, and some ships were laid up, and in any renewal of the shipping contracts the question of ports and internal transport would play an important part. It seemed to the deputation that State assistance given to ports would be far less likely than any other form of State assistance to provoke counter measures by other Governments. Coastwise carriage had fallen off largely because neither the large nor the small ports had provided adequately for its needs. Other countries had spent millions of pounds on their canals and rivers, and in this country millions of pounds had been expended upon roads, but ports had been allowed to fall into disuse. The deputation submitted that the development of British ports and the improvement of their facilities was a pressing need and a sound business proposition. In his reply, Mr. J. H. Thomas said that he had been considering transport facilities, and had had in mind particularly railways, docks and harbours. He felt that developments might be possible in a number of directions. A committee had been set up to examine schemes, the assistance of which would, it is claimed, improve national efficiency, and after meeting the dock and port authorities he felt sure of their good will, in this matter. He recommended those present to get into consultation with other bodies, so that suitable schemes might be submitted for consideration. The larger the number of sound schemes submitted the better he, Mr. Thomas, would be satisfied.

New London Omnibuses.

On Tuesday, August 6th, the London General Omnibus Company, Ltd., introduced on its Victoria Station-Cricklewood Service the first of three experimental vehicles which are to be used in order to determine the best type of omnibus for the company's new building programme. The new pattern of omnibus, which is styled the "L. T." type, will gradually replace the "K" type, introduced in August, 1919. The chassis is of the six-wheel pattern, the two back axles being driven, while all the wheels are fitted with pneumatic tires. The engine, which was designed and built by the Associated Equipment Company, Ltd., of Southall, is of the six-cylinder type, the cylinders having a bore of 100 mm. and a stroke of 130 mm., with a designed total output of 48 B.H.P. at 1000 r.p.m., or 95 B.H.P. at 2500 r.p.m. Special attention has been given to the arrangements for stopping and starting and braking, with a view to giving a higher overall operating speed. In many ways the new omnibus resembles a modern two-deck touring coach, and pleasing innovations with regard to seating, lighting and ventilation have been introduced. The top deck is carried forward over the driver's seat, and there is a half cab to give the driver protection in all weathers. The passenger seating accommodation is arranged for fifty-four persons, twenty-four being accommodated on the lower deck and thirty on the upper deck. A new pattern of seat has been fitted which, it is claimed, gives more room for two passengers side by side than in the existing vehicles. The weight of the chassis is 4 tons 3¼ cwt. The turning circle is 59ft., and there is a clearance under the rear axle of 6½in. The second and third new "L. T." type omnibuses, which it is hoped will be ready in a few weeks time, are to be somewhat larger than the present model, and are designed with a view to their use on the busier interior routes in the London area.

Factories and Air Pollution.

In an interesting report which has been prepared by the Chief Inspector of the Ministry of Health responsible for the carrying out of the provisions relating to air pollution by factory fumes, the opinion is expressed that the scientific control of manufacturing plant has greatly improved in recent years. There is still room, however, for further research into the matter of careful chemical control. The introduction of methods whereby noxious fumes are avoided has not given rise to any hardship to manufacturers, but, on the other hand, has in some cases resulted in the recovery of valuable by-products. In general, the operations at the works inspected have been carried out satisfactorily with few and very minor infractions of the methods proposed. Special work has been carried out with a view to obviate the unpleasant smell which is sometimes noticed in the manufacture of artificial silk and which is caused by sulphuretted hydrogen gas and other sulphur compounds that are given off in the production of the thread. In 1922 about 7000 tons of artificial silk were produced in Great Britain, and in 1927 that amount had risen to 17,000 tons, with a further increase in 1928. In some of the workrooms it is found necessary to renew the air at least thirteen time per hour, which in the larger works approaches 500,000 cubic feet of air per minute. In such a case the quantity of air to be dealt with is very large, and the report points out that the obscure nature of the chemical reactions involved in the manufacture of artificial silk tends to increase the difficulty of finding a suitable remedy for the trouble which exists.

Rail and Road Transport.

Several important developments have recently taken place between the leading railway groups and road transport interests. As already recorded in our columns, agreements have been arrived at within the last few weeks between the London, Midland and Scottish and the London and North-Eastern railway companies on the one hand, and the Scottish Motor Traction Company on the others, with regard to rail and road traffic. The same two companies have also come to an understanding with the road transport interests represented by United Automobile Services, British Electric Traction, and Tillings, Ltd., in respect of road and rail traffic in other areas. Within the last few days the London, Midland and Scottish Railway Company and the Great Western Railway Company have taken steps to acquire the Crossville Motor Company, an undertaking with widespread road services in the North Wales, Cheshire, Lancashire, and adjacent areas. As a result of parliamentary powers obtained last year by the Southern Railway Company, a scheme has just been completed for a "door-to-door" combined rail and road service between certain large manufacturing towns and rural areas within 10 miles from a series of railhead distribution depôts. The centres at present selected for an experimental service include Bexhill, Horsham, Maidstone, Guildford (Shalford Station), and Andover Junction. The goods and merchandise will be conveyed on rail by fast goods trains from the manufacturing towns at cheap rates to the nearest distribution centre, where they will be transferred to the railway company's own motor lorries for delivery to their destinations. In the reverse direction, farm and market garden produce will be collected by motor lorry and conveyed to the railhead depot, where it will be transferred to fast goods trains for forwarding to its destinations. The new arrangement is expected to be equally beneficial to the country districts and the manufacturing towns which will be served by the new scheme.

The German Airship "Graf Zeppelin."

After a preliminary flight over the Rhineland, in which her new Maybach engines were tested, the German airship "Graf Zeppelin" left Friedrichshafen at 3.30 on the morning of Thursday, August 1st, and after a successful Atlantic crossing, part of which was in heavy weather, arrived at the Naval Air Station, Lakehurst, at 9.25 on Monday evening, August 5th. The flight was made in 96 hours 23 minutes, and it is estimated that about 5331 miles were covered. Before landing, the airship cruised over New York, and she then returned to Lakehurst, using the new mooring mast, and was transferred to the shed the following morning. Arrangements were immediately made for refuelling, and preparing the ship for the return voyage to Friedrichshafen, which will form one stage of a proposed flight around the world. This third Atlantic voyage of the airship is looked upon by all concerned as a most satisfactory one, and it was announced by Dr. Eckener and Mr. F. W. von Meister, the American representative of the Zeppelin Company, and Maybach Motors Company, that the construction of four new Zeppelin airships will now be begun, and they will be ready for service in the spring of 1931. The new ships will be twice the size of the present airship and the new terminus will be Richmond, Virginia, which has been chosen on account of the comparative freedom from fog which that part of the coast enjoys. Dr. Leisler Kiep, who was one of the nineteen passengers of the "Graf Zeppelin" and who is a managing director of the Hamburg-American Line, has announced that his company will put its whole organisation behind the building of new Transatlantic airships, for which, he is convinced, there is a great future.

Pulverised Fuel at Sea

The performance of the self-trimming collier "Berwindlea," built for the Berwindmoor Steamship Company, Ltd., and engined by David Rowan and Co., Ltd., of Glasgow, which ran her trials over the measured mile at Skelmorlie on Thursday of last week, August 1st, was most satisfactory, both as regards the mechanical equipment and the fuel economy. The ship, it will be remembered, is the first of her type to be designed exclusively for powdered fuel burning on the Clarke-Chapman system. On four measured mile runs a mean speed of 11·32 knots was attained with the engines running at 65 r.p.m. and good combustion of the fuel. At 70·4 r.p.m. during a straight run from the Clock Lighthouse to the Cumbrae Islands, the ship did 13·064 knots with the tide and 11·965 knots against, giving a mean speed of 12·5 knots. The displacement of the steamer was 5095 tons, and the triple-expansion engine developed 2044 I.H.P., the fuel consumption being at the rate of 28 tons of coal per day. It is of interest to learn that the efficiency of the two Scotch marine boilers worked out at 89 per cent., the coal consumption being 1·28 lb. per I.H.P. hour, and the water consumption 12·5 lb. per I.H.P. hour. The air pressure recorded at the furnace fronts was 2·5in., while the primary air temperature was 530 deg. Fah. The smoke-box temperature was 780 deg. Fah., and the funnel temperature 320 deg. Fah. The general results of the trials seem to promise well for the maiden voyage, which takes place this week, from the Rothesay Dock, with a cargo of coal for Marseilles.

New Atlantic Records.

At 11.30 p.m. on Wednesday evening of last week the North German Lloyd liner "Bremen" arrived at Plymouth on her return maiden voyage from New York, making the eastward crossing in the record time of 4 days 14 hours 13 minutes, at an average speed of 27·9 knots. The "Mauretania," leaving Southampton on Saturday, August 3rd, made a trip to New York, which surpassed her previous record, but she failed to beat the "Bremen's" westward passage by several hours. According to Captain McNeil's statement, the bad weather prevented the "Mauretania" from regaining the blue ribbon on the present trip. Her official mileage and speeds are given by the Cunard Steamship Company as follows:—Saturday to Sunday noon, 498 miles at an average speed of 26·11 knots; Sunday to Monday noon, 680 miles at an average of 27·20 knots; Monday to Tuesday noon, 687 miles at an average of 27·48 knots; and Tuesday to Wednesday noon, 676 miles at an average speed of 27·04 knots. This really fine performance of the "Mauretania" twenty-two years after her maiden voyage reflects the highest credit not only on the designers and constructors of her hull and machinery, but also, to a high degree, on her officers and staff.

The Reclamation of the Zuyder Zee.

No. I.

It would not be apparent to the casual traveller that the kingdom of Holland was overcrowded, for he could travel, in many parts of the Netherlands, for mile after mile through open country scattered with farms and cottages with no large towns and few factories. Nevertheless, the Netherlands rank only second to Belgium in density of population, the number of individuals per square mile being 550, as compared with 391 in Great Britain and Northern Ireland. These figures do not afford any true conception of the actual conditions, for Holland is an agricultural country, and the area of land per head required to support the population is, therefore, much greater than in an industrial country like Belgium. The position is therefore actually more serious than in any other country, and the reclamation of land from water has been the most important national undertaking for centuries past.

The great lakes of North Holland were reclaimed between 1612 and 1640, the Beemster Lake in the former year, the Purmer in 1622, and the Schermer Lake in 1632. The work of reclaiming the great lake of Haarlem was begun in 1848, and completed in 1852. By it an area of 44,470 acres of land was made available for agriculture. These additions to the land not keeping pace with the requirements of the population, it was natural that the Dutch engineers should turn their attention to that great shallow arm of the sea, the Zuyder Zee, which separates North Holland and Friesland, and has an area of approximately a million acres, or nearly that of Lancashire. The first proposal for the reclamation of the Zuyder Zee was made in 1849, shortly after the completion of the work of reclaiming the Haarlem Meer, and the scheme then suggested provided for the reclamation of 1,359,950 acres at a cost of £27,000,000. This scheme, put forward by Mr. van Diggelen, Engineer of the Public Works Department, failed to receive Government approval, and that was also the fate of several subsequent schemes which it is unnecessary to describe here.

In 1886, however, the Dutch Government, at the instance of Mr. A. Buma, the Frisian member of the Chamber, took up the matter, and established a department to investigate both the technical and financial aspects of the problem of the reclamation of the Zuyder Zee. The Government placed in charge of the technical side the late Dr. C. Lely, an engineer of great distinction, whose name will be ever remembered in Holland with respect and affection. The scheme, as finally adopted, was the offspring of his brain, but many years elapsed between the time of his appointment and the commencement of the works. Those readers who attended the Centenary Dinner of the Institution of Civil Engineers will remember that Dr. Lely was present on that occasion and spoke on behalf of the Dutch engineers.

The Zuyder Zee is guarded on the sea side by a number of islands, between which pass deep channels. Generally speaking, it is shallow, the depths in various parts being shown in Fig. 1. It will be seen that the greater part of it has a depth at low water of less than 5 m., and that between it and the islands large areas of sandbanks are dry at low water. The Zuyder Zee receives the discharge of a number of rivers and streams, the chief of which is the Yssel, a branch of

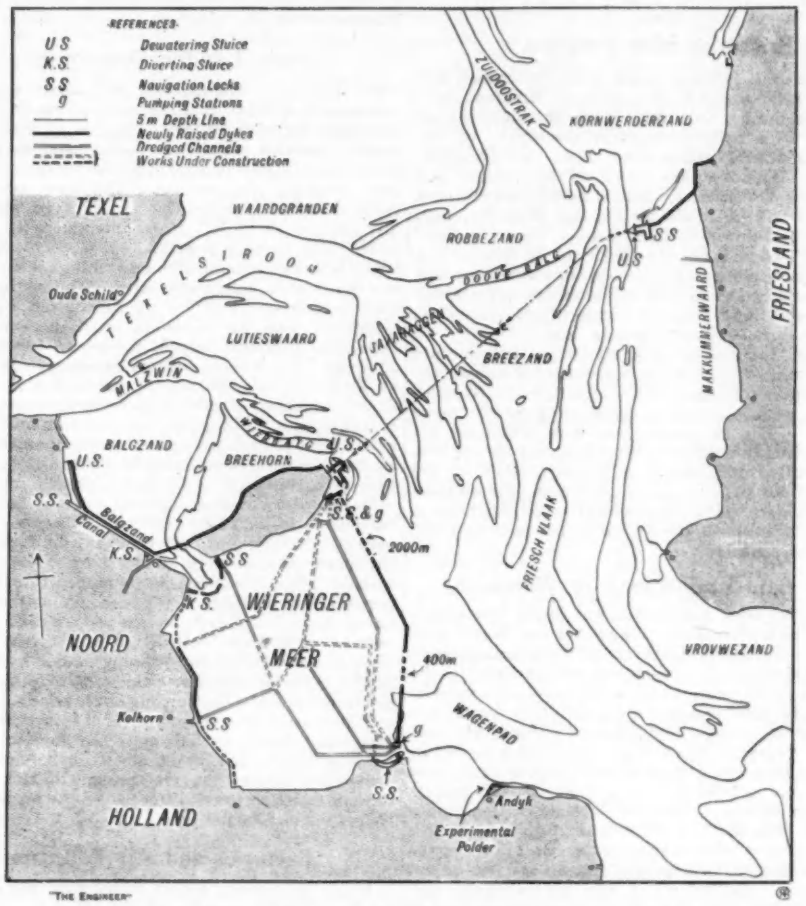

FIG. 3—PLAN SHOWING WORKS COMPLETED AND IN HAND

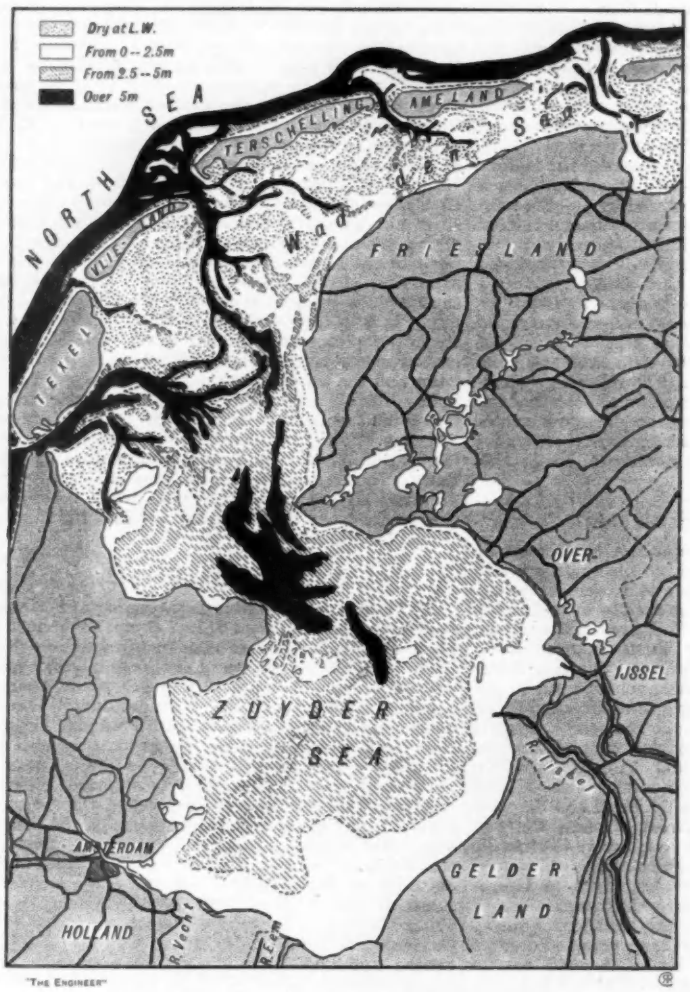

FIG. 1—PLAN OF ZUYDER ZEE SHOWING DEPTHS

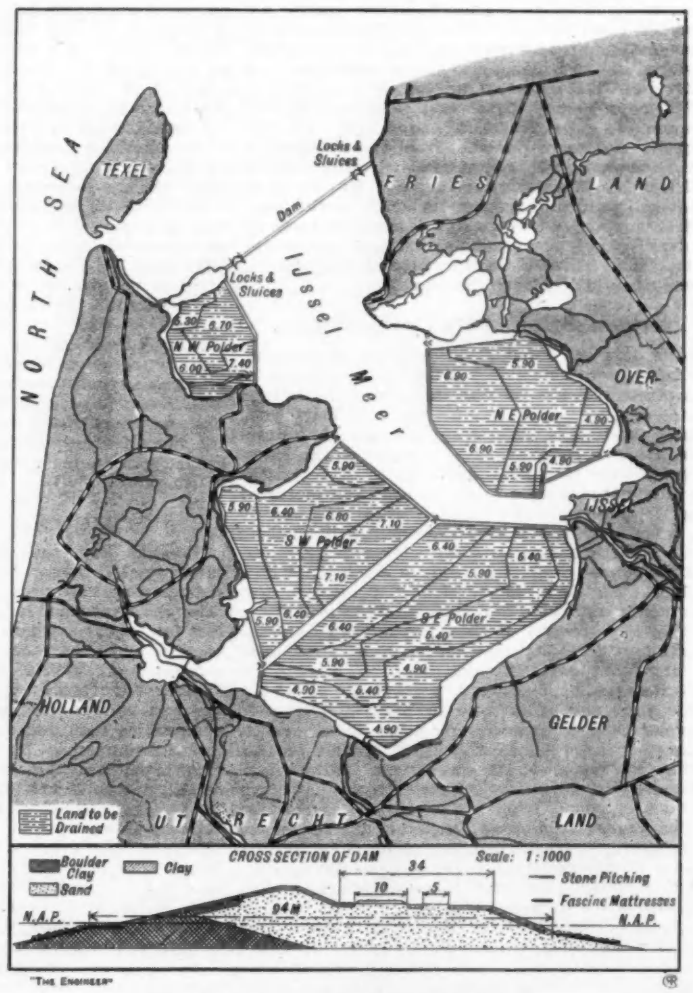

FIG. 2—PLAN OF RECLAMATION SCHEME

RECLAMATION OF THE ZUYDER ZEE

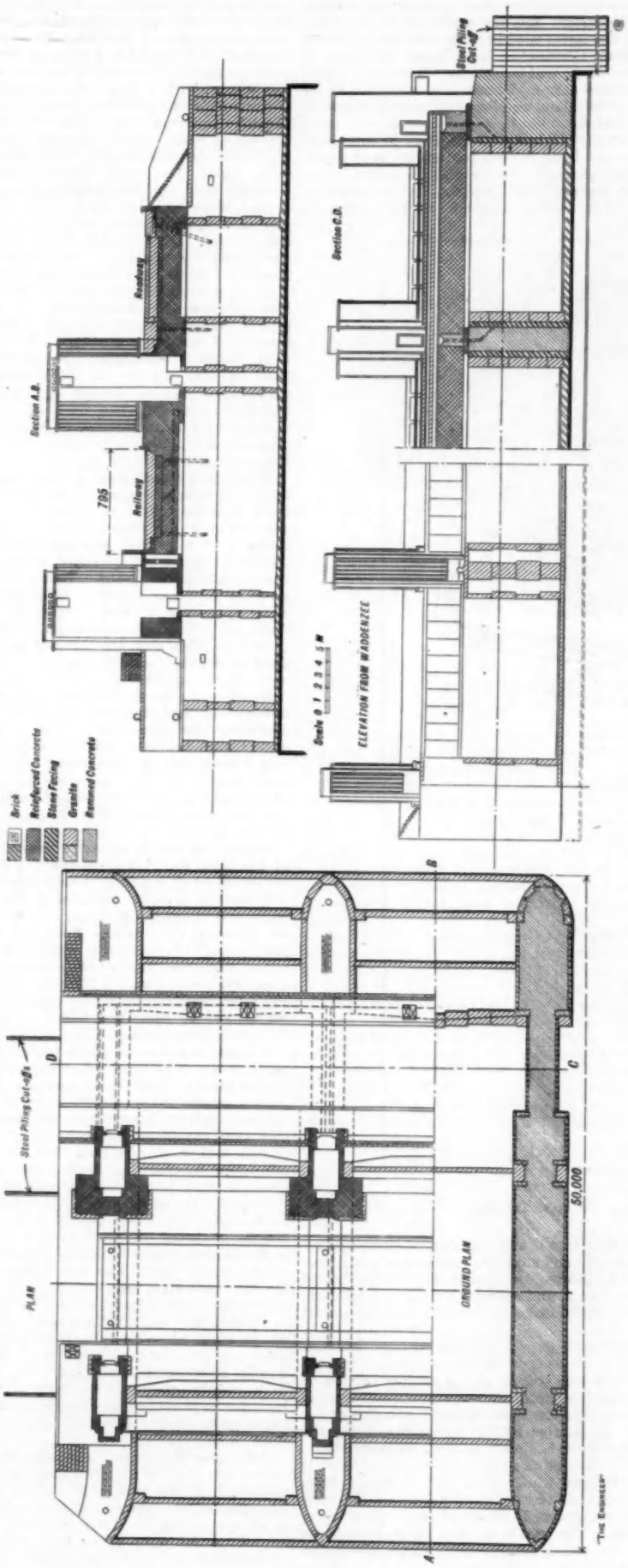

FIG. 4—PLAN, SECTIONS AND ELEVATION OF SLUICES

the Rhine. The bottom, except in the seaward parts, is largely alluvial, and therefore suitable for cultivation when unwatered. In any scheme of reclamation, it was obviously necessary to provide for the discharge of the rivers and also for water access to Amsterdam, and to a number of smaller towns lying on the coast of the Zuyder Zee, the inhabitants of many of which are engaged in the fishing industry.

The scheme adopted is shown in Fig. 2, in which the areas to be reclaimed are hatched. The main dam has been sited so as to take advantage of the island of Weiringen as part of the dam, and also to cross as few deep channels as possible—see Fig. 1. The island of Weiringen has been connected to the mainland of North Holland by a dam about 2 miles in length, leaving a canal, with locks, connecting the existing inland canals with the sea at Helder. North of Weiringen, a main dam, 31 miles long, from Den Oever to Zurig, in Friesland, is under construction.

FIG. 5—BASALT FITCHING ON DYKE

In this main dam three ship locks and twenty-five sluices are being provided. They will be referred to later.

It will be seen that the reclamation, within this main dam, is divided into four main areas, or polders, namely, the North-West, North-East, South-West, and South-East. The deep portion of the Zuyder Zee in the centre, which is to be known as the Yssel Meer, will be left in the form of a large lake, to carry the waters of the Yssel to sea and to safeguard the interests of the fishing industry. Each Polder is surrounded by subsidiary dams or dykes, and waterways, with locks, are provided around and between the polders for communication with the coast towns and internal canals, and to receive the waters of the Eem, Vecht, and other smaller rivers.

The polders, when pumped out, will be kept drained by drainage canals, which are to be dredged in the sea bottom before dewatering the polders, and which will communicate with permanent drainage pumping stations which are to be erected.

The areas of the polders will be as follow :—

	Acres.
North-West	50,000
South-West	140,000
South-East	235,000
North-East	130,000
Total	555,000

This will add 6 per cent. to the land area of Holland, which is at present 9,240,000 acres.

In addition, a small area near Andijk, east of

FIG. 6—STONE, STAKE AND WATTLE WORK ON DYKE

Medemblik—see Fig. 3—has been surrounded by dykes and reclaimed, an area of about 100 acres of sea bottom having been dried for use as an experimental polder for testing crops.

The works generally were begun in 1920, and between that date and 1925 the dam between the island of Weiringen and the North Holland coast, which crossed a main ship channel, was completed and a canal with locks provided to take the shipping, and other preparatory work, the total cost of which, including surveys, was £1,700,000, was done. Under a further Act passed in the latter year, the remainder of the work was authorised, and it is anticipated that the whole will be completed by the year 1952.

The scheme is financially economic, for it is expected that the cost will be eventually covered by the sale of the land. The price which it is anticipated will be obtained is approximately £100 an acre, and such land can be let for £6 per acre, figures which

will astonish British agriculturists when it is remembered that good English farm land can be purchased for £35 per acre, and that on top of the rental of £6 above mentioned, heavy taxes have to be paid for drainage work. It is obvious that such prices could not be realised were large tracts of new land to be thrown on the market at one time; and for that reason, and in order to spread the cost of the work over a number of years, the construction of the subsidiary dykes for all the polders is not to be executed simultaneously, but according to a programme, whereby successive areas are to be made available until the final completion in 1952. For the present only the North-West (Weiringen) Polder is in hand.

The present state of progress is shown on the plan, Fig. 3. It will be seen that, with the exception of two gaps, one of 2000 m. and the other of 400 m., the embankment for the North-West Polder is complete; the sluice and lock pit, or enclosure, at Den Oever and that near Zurig are complete, together with the enclosures for dewatering pumping stations at Medemblik and Den Oever; and a total length of 18½ miles of the main dam is completed or in hand. Included in the works are several basins for the accommodation of dredgers and other plant during rough weather, and some of these are being retained permanently for fishing craft and other vessels.

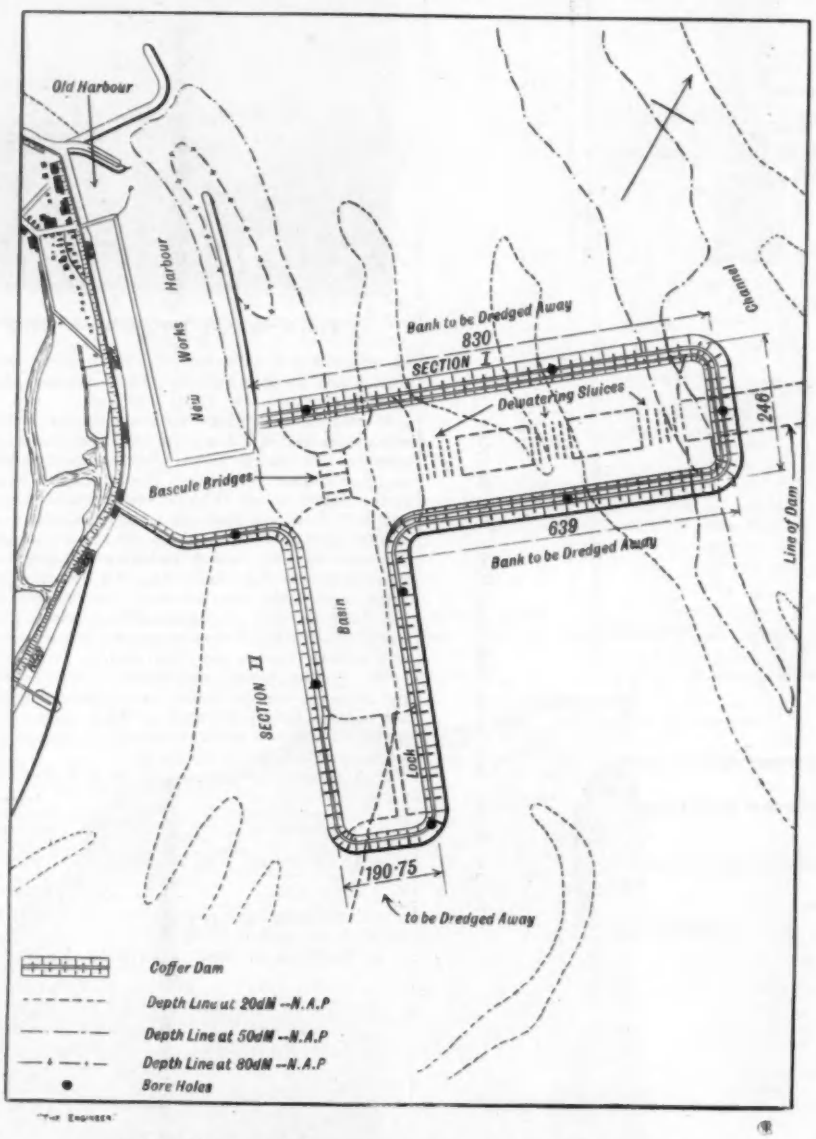

FIG. 7—GENERAL ARRANGEMENT OF WORKS AT DEN OEVER

The following is a description of the various works in detail:—

Main Dam.

The width at base of the main dam naturally varies with the depth of the sea, but a normal section for a depth of 4·50 m. is shown at the bottom of Fig. 2. Here the bottom width is 153·50 m., or approximately 503ft. The width at the crown is 50 m., with a parapet wall next to the sea, and a berm 34 m. wide behind, which will carry a roadway and double-line railway. The height of the parapet is 7·25 m. above N.A.P., the datum for the works, which corresponds to normal sea level at Amsterdam. This height has been determined so that, even in the worst storms, the waves can never reach the parapet level at high water.

The dam is constructed in the following manner:—Boulder clay is dredged from various parts of the bottom by means of bucket dredgers and conveyed to the site of the dam in barges, from which it is grabbed and dumped in position by means of floating cranes. The boulder clay is protected from sea action below water level by depositing, on the surface of the slopes, willow fascine mattresses, which are constructed by hand on shore, launched and towed out to the site, and then sunk by loading with stone. Fig. 8, page 146 shows one of them afloat ready to be towed away, and behind it the launching ways and a stack of willow fascines ready to be incorporated in the next mattress. After sinking in position the mattresses are covered with stone thrown down out of barges, and the portions above water are pitched, the stone used in most cases being basalt obtained from Germany. The basalt pitching is shown in Fig. 5. It will be seen by reference to Fig. 2 that the boulder clay is deposited in a mound along the sea side of the dam, and brought up to a level well above high water.

The remaining thickness of the dam is composed of sand, dredged from the sea bottom by sand pump dredgers, and conveyed to the site in barges, from which it is pumped into position by reclamation pumping vessels. Below water level the sand runs out to a slope of 7 to 1, and this slope is protected by willow mattresses and stone, as in the case of the clay slope in front. Above water level the sand is dressed to a slope of 3 to 1, and covered with a layer of clay, protected by stone, stake and wattle work, as shown in Fig. 6.

The inside of the dam is exposed to very little sea action, and in the case of the embankments for protecting the polders—which are of similar section to the main dam—the inside face of the embankment is dry from the time the dewatering is completed. A view along the parapet of the embankment for the North-West Polder is shown in Fig. 10, page 146.

The upper part of the dam above water level is covered with clay, which is protected from erosion by rain or foot traffic by means of a form of thatching with straw, which has been found very effective for this purpose. The roadway and railway bed are formed in the usual manner with stone bottoming and railway ballast.

Sluices.

Twenty-five sluices, in groups of five, are to be provided in the Main Dam, there being three groups of five at Den Oever, and two at Kornwerderzand, near the coast of Friesland. These sluices, as well as the locks and pumping stations, are being constructed in the dry, temporary embankments being formed round their sites, the water pumped out and the subsoil drained, for the purpose of laying in the foundations, by means of the filter pipe system.

At intervals all round the area to be drained, wrought iron pipes, 12in. diameter, are sunk by means of a water jet. The lower ends of the pipes are open, but are inserted into cast iron shoes or caps, having a small hole in the centre for the passage of the water jet pipe. When the pipes are sunk to the requisite depth, usually some 6ft. below the lowest foundation level, the water jet is withdrawn, and an internal pipe, made up of wooden segments, is placed in position. The wooden pipe is made up of four or five segments bound with hoop iron, and is closed at the bottom with a plug. Each segment has a series of horizontal saw cuts in it, about an inch apart, and of such thinness as to permit of the passage of water, but not of sand. The plugged bottom of the wooden pipe rests upon the inside of the cast iron shoe of the outer pipe. The space between the inside of the wrought iron, and the outside of the wooden, pipes is then filled with pea gravel, and the wrought iron pipe is then withdrawn, leaving the cast iron shoe in the ground. The wooden filter pipe then remains surrounded by a casing of pea gravel, and the water from the subsoil flows into it practically clean.

An iron suction pipe open at the bottom is then lowered inside the wooden filter pipe, and this suction pipe is connected up to a suction main leading to the temporary pumping station. By this means the water table is effectually lowered to the necessary level all over the site of the foundations, and the excavations can be carried out in the dry. The hydraulic gradient rises from a point somewhere in the length of the filter pipes, regulated by the rate of pumping, to the sea bottom outside the surrounding temporary dams.

The sluices are all alike, and two of them, namely, two outer sluices of a set of five, are shown in Fig. 4. Each sluiceway is 12 m. wide with a depth on the sills of 4 m. at low water, the total height of the gates being 6·90 m. Each sluiceway contains two electrically operated rising sluice gates of steel, and a pair of automatic gates. The sluiceways are constructed of mass concrete, with granite-faced cut-waters—see Fig. 9, which shows the inner—Zuyder Zee—end of one set of sluices under construction. It will be seen that the cut-waters are faced with slabs of Swedish granite, the side walls being faced with ashlar masonry.

Reinforced concrete bridges will carry the road and railway over each sluice, and the sluice gates and gate-operating machinery are carried by reinforced concrete towers between each pair of sluices. The bridge and towers can be seen under construction in the engraving. Fig. 13 illustrates the outer—sea—end of the same group of sluices. The cut-waters in this case are faced with ashlar masonry in panels with granite between.

Heavy concrete wing walls, formed to the contour of the main dam, so as to effect a junction with it, are provided at the ends of each group of sluices. To prevent the possible seepage of water along these walls and through the dam, cut-offs of steel piling are driven at three points along the end walls, these piles being 10 m. long. These cut-offs are shown in the engraving in Fig. 13 on page 146, which gives a general view of one of the end walls. Similar cut-offs have been driven for the side walls of the locks, which will be described later. The piling used is "Larssen" steel piling, 17in. by 5in. and 1 cm. thick.

For the purpose of constructing the sluices and other works, steel concrete pouring towers were used. One of them is shown in operation in Fig. 14, which is a view of one set of sluices from the end, with the sluice-operating towers under construction. In this view the tower nearest to the camera is completed, and it will be seen that the surface of the reinforced concrete has been coated with bitumastic paint, a practice adopted throughout the work.

Owing to the absence of any large gravel or shingle in Holland, small pea gravel is used as aggregate, the gauge being uniformly about ⅜in. It is mixed in the correct proportions with the sand in a concrete mixer, whilst dry. The mixed sand and aggregate is then discharged into wagons and conveyed to the site of the work in hand, where the cement and water are added and the whole remixed in another mixer, all the plant being electrically operated. Very heavy steel bars are used in some parts of the reinforcement. In Fig. 12 is shown a group of 5 cm.—2in.—diameter bars, closely spaced in the base of a tower. These bars are bent cold in an electrically-driven bar-bending machine on the site of the works, no forging being done on any of the steel.

Adjoining the sluices, and opposite the lock next to be described, is an open channel, over which the road and railway will be carried by bascule bridges. The general arrangement of the works at Den Oever is shown in Fig. 7. The three sets of sluices are shown on the right of the plan, adjoining the commencement of the main dam in the direction of Friesland. Next to the sluices is situated the channel above mentioned, which is spanned by the road and rail bridges. On the Zuyder Zee side of this channel, a permanent basin has been formed, from the inner end of which the lock communicates with the Zuyder Zee. South of the lock and channel, and parallel with the shore of the island of Weiringen at Den Oever, is a harbour for plant.

(*To be continued.*)

Transformer Tap-Changing on Load.

No. V.*

ONE of the systems of tap changing under load adopted by the British Thomson-Houston Company is the external reactance system shown in the diagram, Fig. 39, which is self explanatory. The scheme is applicable to single or three-phase transformers of large or small outputs. Apart from the driving mechanism,

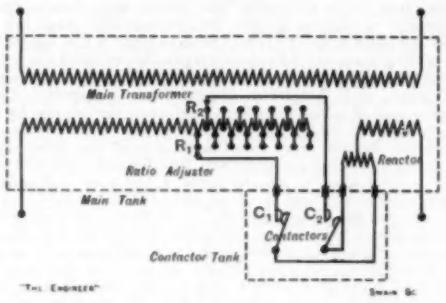

FIG. 39—B.T.H. TAP-CHANGING SCHEME

all the equipment, comprising the main transformer windings and tappings, twin tapping switches, cam-operated contactors, intermittent gear, and reactor, is immersed in oil. The tapping switches, intermittent gear and reactor are inside the main transformer tank, and the contactors in a separate tank attached to the front or side of the main transformer tank,

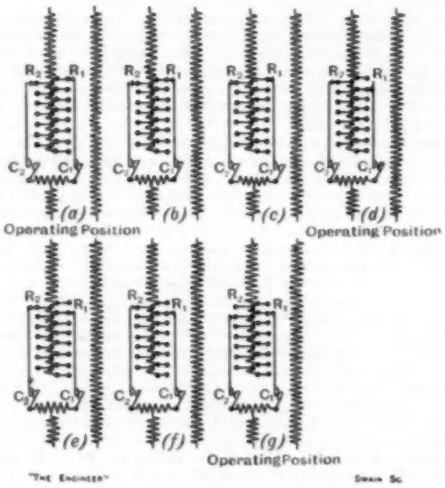

FIG. 40—TAP-CHANGING CONNECTIONS

whilst the driving mechanism is in a steel housing above the contactor tank.

The makers draw attention to the following merits of the gear :—(1) Uniformity of voltage steps irrespective of the load power factor; (2) minimum number of circuits brought outside the tank; (3) the operations of tap changing and circuit interruption are quite separate, as the tapping switches are only used for selecting the required tapping, and do not "make" or "break" circuit, which, as usual, is done by the oil-immersed contactors; (4) maintenance is reduced to a minimum, as only two circuit interrupting devices—*i.e.*, contactors—are used per phase; under ordinary service conditions the arcing contacts do not require inspection except at infrequent intervals; (5) the voltage regulation is obtained without phase displacement; (6) no part of the winding of the transformer or the reactor is subjected to overload during operation; (7) the equipment is self-protecting, and no protective gear is therefore required to deal with incomplete operation in changing from one tap to the next; (8) possible troubles owing to oil leakage through tapping bushings in the tank sides are eliminated as the tappings are connected to the tapping switches by short lengths of well-supported leads inside the tank, and these switches are arranged alongside the winding; (9) all the equipment is self-contained as one unit, and occupies a minimum amount of floor space; (10) the number of switching operations per tap change is the lowest possible, as may be seen from Fig. 40; (11) on all tappings the windings are in complete balance with one another.

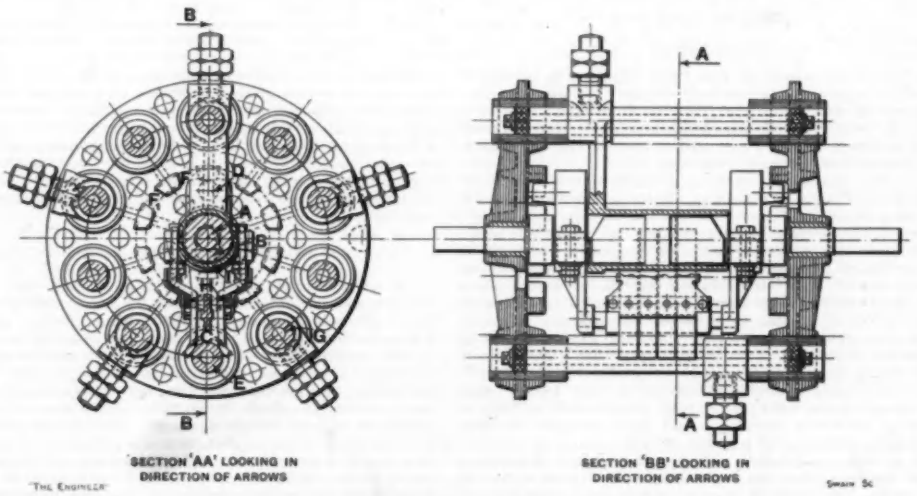

FIG. 41—ARRANGEMENT OF TAPPING SWITCH

The tapping switches, which are motor-operated, are actuated by means of an excentric, so that with light torque on the excentric shaft heavy pressure is placed on the spring-loaded finger type contacts, as they wipe into position on the vertical studs, and as these tapping switches are only used for selecting the required tapping, their contact surfaces are always in the best condition for making full contact.

The operation of the tapping switch will be understood from Fig. 41. Rotation of the operating shaft A causes the crank shaft B to rotate around the centre of shaft A. The carrier for the contact fingers C is attached to the crank shaft B, the carrier being free to turn on the crank shaft. The pin D is fixed to the carrier. When the operating shaft A is rotated in the direction indicated by the arrow, during its first movement the crank shaft B attempts to push the contact fingers to the left, but owing to their being in contact with the rod E they rotate about rod E, with the result that the far end, to which the pin D is attached, moves round until the pin D is opposite the slot F. Further movement of the crank shaft B causes the fingers C to be withdrawn from the rod E and the pin D moves into the slot F. As the crank shaft B rotates still further it attempts to push the pin D to the right, but owing to the pin being in the slot F, movement of this pin is prevented and thus the fingers C are caused to rotate about the pin D until opposite the next contact rod G. Further movement of the crank shaft B causes the fingers C to be pushed into contact with rod D and the pin withdrawn from the slot F. The last portion of the movement of the crank shaft B gives pivoting about the rod D, which brings the pin D midway between the slots F and F_1. The fingers C are now making full contact with the contact rod G and are held in contact with the contact rods by the pressure of the springs H. The sliding motion of the contact fingers both on the rods E, G, &c., and on the centre contact rod I ensures that good contact is made.

The intermittent gear and group of tapping switches

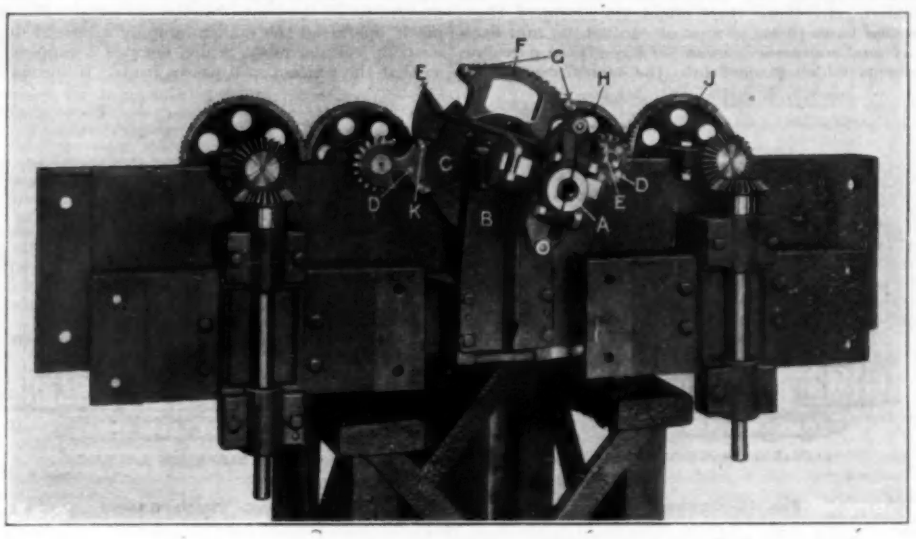

FIG. 42—INTERMITTENT GEAR

for a three-phase transformer are shown in Figs. 42 and 43. Each group of tapping switches is connected by insulating couplings to the intermittent gear which is arranged to bring each group of tapping switches up to speed gradually and to cause their operation without mechanical shock, also to lock in their correct relative positions not only the two groups of tapping switches, but also each tapping switch during the operation of the other. The intermittent gear is driven through universal joints, and, as it is oil-

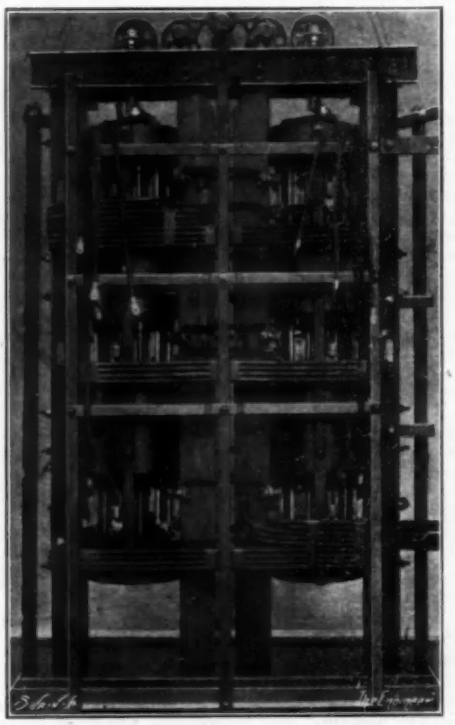

FIG. 43—GROUP OF TAPPING SWITCHES

immersed, easy operation is assured and mechanical deterioration in service prevented. The operating sequence naturally consists of moving first one and then the other tapping switch to a new position, the corresponding oil-immersed contactor being open during each move of the tapping switches. The operating shaft A is supported in a bracket B and is connected to a cam C which slides over the curved portion of the pinion D to keep the tapping switch in its normal position during the opening of the

H

* No. IV. appeared August 2nd.

contactor. At this stage a roller G on the toothed sector F presses on a recessed portion of the pinion D so as to cause the pinion to rotate until its teeth come into mesh with the teeth on the sector F, the further rotation being completed by direct tooth drive. During this period a tapping switch is being moved by the wheels H and J. At the end of a tap change the jaw-shaped projection E rotates the pinion D back to its normal position by pressing on one of the rollers K fixed to the pinion D. The mechanism is now ready to effect a further tap change when required.

The general arrangement of a B.T.H. three-phase outdoor type oil-immersed self-cooled transformer, with tap changing on load equipment, is shown in Fig. 44; whilst Fig. 45 shows a similar equipment. The tank attached to the front of the main transformer is that in which the oil-immersed contactors for interrupting the current carrying circuits are situated. In these three-phase transformers there are two three-phase groups of contactors, and each individual contactor is mounted directly on porcelain bushings which project into the transformer tank.

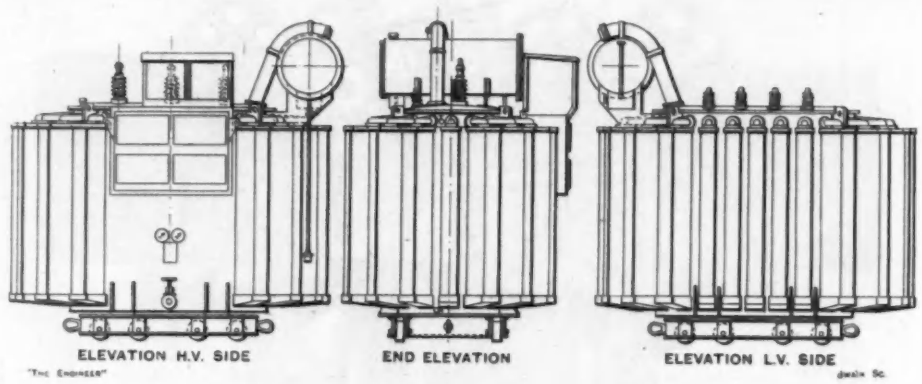

FIG. 44—GENERAL ARRANGEMENT OF B.T.H. TAP-CHANGING TRANSFORMER

These bushings are fixed to a heavy steel plate, which is bolted together with a cork gasket to the side of the transformer tank. Each contactor has two sets of current-carrying contacts; one for normal operation and the other of the arcing contact type, for rupturing the current during the opening of the circuit which takes place when a tap-changing operation is being carried out. The necessity for main and arcing contacts when rupturing a circuit under oil is far greater than when the rupture takes place in air.

When breaking a circuit under oil it is not possible to ensure that the arc will be led on to the tips of the contacts, as can be done with air break contactors. Moreover, as the arc is confined, the burning is much more severe under oil than it is in air, with the result that the "breaking" contact surface

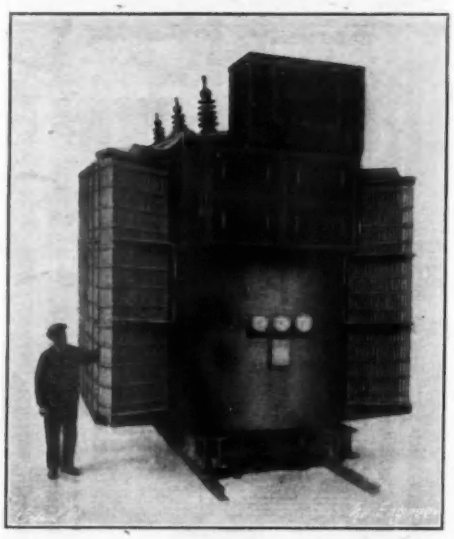

FIG. 45—B.T.H. TAP-CHANGING TRANSFORMER

becomes very rough and unsuitable for carrying current continuously. Any deterioration in the current-carrying contacts is therefore confined to the arcing contacts, and convenient arrangements are included for inspection, adjustment or replacement, although inspection should not be necessary until after about 7000 operations have been performed.

The contactors are operated by cams and a quick break is obtained by means of a toggle mechanism. The motor-operated driving mechanism is housed in the steel tank above the oil tank containing the contactors, and is arranged in such a way that it is unnecessary to provide oil-tight stuffing-boxes, which are liable to become a source of nuisance after the equipment has been installed.

The remaining equipment consists of reversing contactors, a motor brake, a cut-out switch, and a drum controller mounted on the main operating shaft, in order to ensure the completion of a change of a tapping, once the operation has begun. There is also a dial switch, and a visual position indicator is provided when desired. If it should be necessary to operate the gear manually, the motor may be disengaged by means of a clutch. All the bearings are conveniently grouped for oiling and inspection, and the complete operating mechanism is assembled as a single unit on a heavy steel plate and enclosed in a waterproof housing.

The control gear may be arranged for local manual operation or electrical operation by means of push-buttons situated nearby or at a distance, and with the addition of voltage relays the equipment can be made suitable for automatic operation. Once a tap change has been initiated, the cycle of operations cannot be interrupted until completed by further movement of the control switch or relay. For automatic operation the makers employ a special double element voltage relay, which ensures a snap action, so that the contact arm passes readily from one contact to the other. The use of this relay overcomes any possible trouble of fusing or bad contact, owing to arcing at the contacts, which may be experienced with a single element relay having a moving contact floating between two fixed contacts or with the usual type of contact-making voltmeter. Reverting to the diagram of tap-changing circuits, Fig. 40, where R_1 and R_2 represent the tapping switches and C_1 C_2 the contactors, it will be seen that at *a* the contactor C_1 is closed, and the minimum voltage is in use. When changing to the next tapping the sequence of operations is as follows:—(*b*) contactor C_2 is closed; (*c*) contactor C_1 is opened, and the change in the voltage is made; (*d*) tapping switch R_1 is moved to the next tapping ready for another voltage change; (*e*) contactor C_1 is closed; (*f*) contactor C_2 is opened and (*g*) tapping switch R_2 is moved to the next tapping. Even in the event of the sequence of operation not being completed, owing to any cause, the transformer remains connected to the system with a voltage change equal to half the normal tap change, and no overload is thrown on the tapping coil or reactor. Protective gear is therefore unnecessary.

(To be continued.)

Science and Engineering.*

By Professor F. C. LEA, D.Sc.

(Concluded from page 127)

STRUCTURES.

THE indebtedness of structural engineering to mathematics and to experimental science has already been suggested, but these powerful aids to progress had to be supplemented by the development of new materials and by a direct experimental attack before the remarkable achievements of recent times were possible.

In this respect it is well to go back occasionally to the work of William Fairbairn, who was President of this section in 1862. He carried out his classical experiments during the 'forties of last century to determine stable forms of compression elements for structures, and upon his experiments practice followed rather slavishly for more than forty years. The failure during erection of the cantilever of the Quebec Bridge dramatically forced attention upon the problem of the stability of compression elements. Again a series of experiments filled the gap in knowledge and led to success. Further work on a large scale, the cost of which can probably only be undertaken by public authorities, is desirable. During the last twelve years attempts have been made, with considerable success, to design all-metal aeroplanes and rigid airships, the compression elements and beams of which must of necessity be as light as possible. With a fair degree of precision the external forces can be determined by experiments upon models. The structure of an aeroplane has a certain degree of "statical indeterminateness," but the forces and the bending moments in the elements can be approximately obtained, and what might be called the primary stresses can be found with the same degree of approximation. Three serious difficulties immediately, however, faced the designers: (1) materials of a suitable character and in a suitable form for constructing the very light but strong elements; (2) the lack of technical skill and suitable machinery for building up the elements; (3) the lack of knowledge and the almost insuperable difficulty of determining by analytical methods the secondary, and what might be called stresses of even higher orders of indeterminateness. The only way was a courageous combination of experiment and mathematical investigation. The one without the other was useless, but by a combination of the two rapid progress was made, and to-day all-metal planes are being constructed of steel or of duralumin which are as light, more durable, and stronger than the planes made of the best spruce.

No new fundamental knowledge, such as the splendid contribution of Navier or of Euler to the theory of elasticity, has come out of the work, but, taking these fundamental formulæ as faithful guides, the experiments have led to the developments of forms which, allied to the ingenuity of skilful designers, have made it possible to build machines fully equal to the very onerous conditions of lightness, strength, and durability imposed upon aircraft. Fairbairn and Hopkinson, when experimenting on the forms to be adopted for the compression elements of the Britannia Tubular Bridge, were faced with almost the same difficulties, but their problem was simplified in one respect. They were able to use wrought iron plates and angles sufficiently thick and rivets of sufficient diameter to make it unnecessary to consider the instability that may occur in the plates between adjoining rivets or in the web of the angles. This is not the place, nor is there time, to consider in detail either the early or later experiments, but only to refer to them to illustrate how rigidly controlled experiments were essential to the development of metal bridges and aeroplanes.

There is still, however, a great deal to be done in connection with structures, and the only hope of a satisfactory solution of many problems is not simply by accumulating experience, but by combining experience, experiment, and mathematical analysis in an endeavour to reduce the whole to definitely co-ordinated knowledge. Nearly thirty years ago I was privileged to assist with some experimental work on the deflection of bridges produced by rapidly moving loads. They were incomplete, but they definitely indicated that the assumptions often made by engineers as to the effect of rapidly moving loads were not justified. In view of the publication in the early part of this year of the report of the Bridge Stress Committee, published by the Department of Scientific and Industrial Research, of which perhaps it is only necessary to say that it is worthy of its distinguished chairman, Sir Alfred Ewing, and his colleagues, it is fitting to particularly refer to this subject of impact on bridges.

As early as 1849, in the Report of the Royal Commission on the use of wrought iron in railway bridges, the subject was discussed and Sir George Stokes gave a mathematical solution for a load moving over a girder, but this solution was of little value in practice. For eighty years the effect of travelling loads has been treated in an empirical illogical manner and a number of impact formulæ, which the Bridge Stress Committee Report shows have no valid foundation, have been rather blindly used by engineers. The report shows very clearly that what is important is not the fact that the load is applied suddenly to the structure, but the possibility of synchronism or otherwise of the structure with the periodicity of unbalanced forces due to the engine or to other causes. Experimental data of the vibrations produced in the structure by the various types of moving loads have been carefully obtained and methods of analyses developed which have made it possible to determine with some degree of precision the true impact factors to be applied. Thus a problem of real difficulty, in connection with which doubt and uncertainty has probably led to expenditure far greater than the necessities of the case demand, comes within the possibilities of solution. The carefully conducted work of the Committee spread over a few years has given more precise guidance for future designers than a hundred years of practice. It may quite reasonably be said that practice in the past has led to safety. That certainly must always be the first consideration, but undue safety involving the use of too much material or even too narrow a margin of safety by using materials unsatisfactorily cannot be said to be good engineering, and engineers as well as the general public—for whom engineers are trustees—cannot be satisfied until all uncertainties that can be removed by careful scientific inquiry give place to more accurate knowledge. The only hope of completely solving this all-important problem, as well as the equally important problem of the distribution of load through various types of floors to the girders of both steel and reinforced concrete structures, is by direct large-scale and model experiments and by that type of co-operative action of the scientist and practical engineer which has achieved such splendid success in connection with the work of the Bridge Stress Committee. It is also of interest to note that history has repeated itself in that the great contribution which Fairbairn made to structural engineering was only possible, as he himself admitted, by the co-operation of the practical engineer and the mathematician.

AEROPLANES AND AIRSHIPS.

The development of the forms of aeroplanes and rigid airships and the determination of the forces acting upon them—lift and drag—and the distribution of these forces, is another illustration of the splendid use that can be made of the combination of experiment and mathematical analysis. Following the fundamental principles of Newtonian mechanics, dynamical laws of similarity have been developed which in combination with the wind chambers and the precise measuring devices used for the determination of forces and moments acting upon models have made it possible to anticipate certain of the forces acting upon machines. Other forces could only be estimated from meteorological data obtained from an examination of the velocity of upward and downward currents of air which a ship or aeroplane may suddenly encounter. Much could be said of the many other contributions of "pure science" to the successful development of the aeroplane. Many of the details and instrumental equipment owe much to science, but success could not have been achieved if these gifts had not been supplemented by the application of the experimental method, in which precise measurement has played an important part, to the solution

*British Association. Section G. Presidential address delivered in Cape Town, August 1st, 1929.

of the specific engineering problems associated with the engine and the structure.

MATERIALS.

Allied to the subject of structures is that of the strength of materials and their behaviour under various types of stress. For nearly seventy years experiments have been carried out to determine the effect of repeated stresses on metals, but the development of high-speed machinery during the last twenty years has focussed attention upon this important subject, and it is now realised how imperfect is our knowledge. A vast amount of experimental data has been accumulated, and it has been clearly shown that the safe range of stress to which a piece of material can be subjected for, let us say, an indefinite number of times depends in some way, not yet clearly defined, upon other and more easily determined physical properties. But it is not yet always possible to foretell that some element of a locomotive or of an aeroplane engine, or structure, or other machine will not fail under the conditions it has to meet in practice. Small discontinuities in the structure of wheel tires, a surface defect in an axle, a wheel gripping very tightly on an axle at one section, surface cracks which cannot even be seen by the microscope on a wire used for a rope, or in the disc of a steam turbine rotor; the surface condition of a quenched and tempered spring used for a locomotive, an aeroplane engine, or a motor car may lead to failure under the repeated stresses due to the normal forces acting upon the element, or due to repeated blows, such as, for example, a locomotive experiences whenever it passes over a rail joint, or a motor car along a road. Cam shafts for the stamping mills, used in the gold mines in the neighbourhood where we are, frequently fail, and engineers and metallurgists are often at a loss to give a reasonable explanation. The whole problem is bound up, not only with the physical properties which statical experiments are capable of testing, but apparently in some unknown way with the nature of the crystal structure of a metal; perhaps the stress that produces fracture depends upon the distribution of very small quantities of so-called impurities in the space lattice of the crystal, or upon the nature and properties of the material forming the crystal boundaries, and upon the surface conditions, including hardly perceptible corrosion, as well as the existence of other discontinuities incidental to the manufacture of metals. Some metals appear to fail by slipping on the crystal plane, and others by cracks commencing at crystal boundaries, or at surface discontinuities. To the metallurgists, engineers must unstintingly pay tribute for the splendid work they have done in supplying materials to meet the ever-growing and exacting needs of modern engineering. By the careful scientific control which characterises a modern steel works, thousands of tons of apparently uniform material can be turned out, but the engineer does not always use the materials as they should be used, and the metallurgist has not always the knowledge required to ensure perfect reliability under the exacting conditions of service. These, allied to the difficulties to which reference has been made, make it imperative that in this problem of the reasons for failure of metals under repeated stresses and their prevention the co-operation of engineers, metallurgists, physicists, and mathematicians must be enlisted; experience alone is by no means satisfactory.

Incidental to the failure of materials in service, the recognition of synchronism as an important contributing factor, and the assistance given by experiment and dynamical theory in anticipating synchronous speeds has been of the greatest service in the design of modern high-speed machines. Crank shafts of aeroplane engines and of internal combustion engines have been known to fail in a few minutes because designers have failed to recognise the possibilities of synchronism. Such disasters can now be avoided in many cases.

ROADS.

Before concluding I should like to refer to another subject of interest. The rapid developments of road traffic during the last quarter of a century has made the road problem one of considerable importance. From the point of view of the user and the community, the general policy of road construction, the capital expenditure involved, and the cost of upkeep are of primary concern. These are dependent upon the materials available and the use made of them. Incidental to the problem is that of vibrations produced in structures adjoining the road and the probable damage accruing from them, but of this there is only time to say that experiment is necessary to determine the importance of these vibrations on the materials of structures.

Reference has already been made to the lack of knowledge of the effect of blows and stresses due to vibrations in causing failure in metals, and the lack of precise knowledge which will make it possible to choose with assurance the particular material to meet certain circumstances. The problem of road surfaces is in a large measure one, not only of the suitability of materials to resist impacts, but also of the prevention of impacts. An old philosopher, Desagulier, as long ago as 1714, argued with a direct simplicity worthy of a scientific man of eminence that a piece of glass could be struck many small blows without fracture, but one large enough would splinter it in pieces, and that a four-wheel wagon passing over a horseshoe might strike such a small blow that little damage would be done, whereas a two-wheeled wagon carrying the same load might destroy the road surface quickly. The problem might be slightly differently stated to-day, but in principle the difficulty is that suggested rather quaintly by Desagulier. Many experiments of actual road surfaces are being carried out in all parts of the civilised world, but considering its economic importance, the cost of upkeep of roads and the inconvenience of repeated repairs, it would appear that it would be well worth while, even though there may be doubt as to whether any definite and final conclusions can be reached in the laboratory, to let carefully but boldly conceived laboratory experiments direct the large-scale experiments much more than at present. If the history of other engineering developments is to repeat itself, only by such a procedure is the solution likely to be found. In many branches of engineering, materials and precision of finish have brought about remarkable developments, and if, by close control of processes, plane road surfaces that will reduce blows to a minimum can be constructed of materials having a reasonable coefficient of friction, a sufficient degree of resilience and abrasive resistance, real advances may be expected. Steel, rubber and many other materials have been suggested; it may be that the chemist has by no means said the last word on the possibility of synthetic substances that will fill the bill; but, however that may be, whether in the direction of new materials or in the better use of materials that are available, it seems clear that roadmaking has become of such economic importance to the world that it should be removed from the category of "trial and error" which for centuries has been the method of advance, and all the aids that science can give should be enlisted to achieve the desired end. It is not intended to suggest that science is not at present assisting. The chemist is controlling the manufacture of cements, so that products of great reliability are available from the various firms manufacturing cements; tars and bitumen and other materials of a mastic character are determined in consistency and properties by the control of physicists and chemists; india-rubber vulcanised under definite chemical control is being tested in road surfaces; certain substances like silicate of soda have been introduced as dressings to concrete; laboratory tests have been made in connection with concrete and other materials, but in the field concrete is not by any means made under that rigidity of control necessary for a product of known properties to meet particular conditions; it seems clear that many miles of main roads have been made of concrete, suitable perhaps for some purposes, but not of the mixture necessary to meet conditions of heavy road traffic. But in the direction of research for new materials, as well as in the control of the manufacture and of the properties of known materials and in the actual carrying out of the work in the field, science and the scientific method seem to be the necessary aids for future progress.

There is another aspect of the subject which is perhaps related more to economics than to engineering, but it nevertheless demands a definite scientific approach, rather than a policy of drift. I refer to what has almost become a contest between road and railway development. At home there seems no doubt that thousands of tons of heavy materials are carried upon roads, with some element of convenience, it is true, that should be carried on rails, at much greater gross cost to the community than if sent by rail. The calorific value of the fuel consumed per ton-mile and consumption of other materials is greater for road than for rail transport, and the actual damage done to road surfaces and vehicles is much greater for the heavy loaded road vehicles than for rail vehicles. True it is that flexibility, direct delivery, and many other advantages are claimed for road traffic which may far outweigh the disadvantages just referred to, but a failure to visualise the problem of internal transport as a whole may lay unnecessary burdens upon the community. In the opening out of new country that may be the problem in South Africa. I venture to suggest that a courageous but, as far as is humanly possible, a "scientific" policy of development by road and rail should be followed.

The argument of this address can be summarised into a few sentences. New epoch-making developments in engineering depend upon the discovery of new facts of science and upon materials and technical processes. The only hope of solving many of the problems which face the engineer to-day is by carefully organised experiment. Engineering is of such vital importance to modern life that not only manufacturers but large users, public authorities, and governments must be interested and provide funds for research.

In Great Britain a good deal of engineering research is being done by large firms, by research associations connected with certain industries, by the universities and by the technical colleges, the National Physical and the Building Research Laboratories, which are under the direction of the Department of Scientific and Industrial Research. This Department also assists research associations by grants, and the universities by the provision of research scholarships and research assistants, but at present it seems that sufficient research is not being done, and that not nearly enough researchers are being trained to meet the needs. How can the demands of the case be met?

It would appear that we must look largely to the universities to train researchers. I suggested that I wished to avoid the subject of the training of engineers, but one word I wish to say and that is to refer to the necessity for the training in the universities of a considerable number of engineering students with the research outlook. Training in strict habits of observation and in the investigation of problems theoretically and by experiment should form part of the work of all engineering students. Much of the theoretical knowledge that a young engineer requires to learn is now to be found in excellent text-books and in current periodicals, and these he should be taught to read critically and with understanding, but he should also be taught to face all his problems in the spirit of an investigator. Certain selected students should be encouraged to remain at the universities after graduation or to return after some experience of actual works to engage specifically in research. Engineering needs such men, some to give their whole time to research while others carry the spirit of research into the ordinary problems of industry and engineering. Employers, public authorities, and governments must utilise this research ability, and more men should find their way into industry from the research institutions. The universities, however, cannot do this most important work of training researchers unless they are adequately equipped and staffed to give members of the staff the necessary time for research and to devote themselves to the training of students in research. To this end sufficient funds must be provided from private and public sources.

In the time allotted to this address it has been impossible to do other than refer briefly, and perhaps unconvincingly, to the importance of research in engineering. It has not been possible to refer, nor should it be necessary, to the indebtedness of engineering to craft ability, upon which success so often depends. One word, however, should be said about the desirability of training engineering craftsmen to the appreciation of the scientific problems underlying their craft. When this can be done, and much more is possible than at present, it leads to an increase in efficiency and adaptability, to a greater tolerance and interest in new methods, and in the immediate task. It also leads them to appreciate the relationship of their problems to the great world of Nature, and thus to a widening of that interest to which the work of this Association is directed.

The engineer is faced with many unsolved problems. Nevertheless he must find immediate, if only approximate and tentative, solutions to many of them, and in the solution he often has to deal with many types of men. If experimental science and mathematics cannot give him an exact solution he must still carry on, and in this way much has been achieved. It is for this reason that the engineer has to learn much by actual experience in the workshop, in the field, and frequently he becomes impatient of science and lays too great emphasis upon experience. Manufacturers wish to see returns upon their capital and remuneration for their energy, but as an effective guarantee of future progress and in the solution of many problems in design, in processes, in materials, as well as in the discovery of new methods, it is necessary, as Francis Bacon would to-day remind us, "to apply natural philosophy to particular problems and particular problems must be carried back to natural philosophy."

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

A FAST CONTINENTAL TRAIN.

SIR,—Noticing the reference in your issue of July 12th last to the train between Swindon and Paddington on the Great Western Railway, which is booked to accomplish the journey at the rate of 66·21 miles per hour, it has occurred to me that your readers might be interested to hear of a French train, the running of which has recently been accelerated.

The Swindon–Paddington train, which does the 77¼ miles in 70 minutes, is certainly the fastest train in the world, but for a long distance run of over 450 miles, the "Sud Express" can, I think, claim to be the fastest train in Europe.

The "Sud Express," which runs between Paris and the Spanish border over the systems of the Paris-Orleans and Midi Companies, is due to leave Paris (Quai d'Orsay) each day at 10.40 a.m., and to reach Bayonne after seven stops—Paris (Austerlitz), Orleans, (Les Aubrais), Tours (St. Pierre des Corps), Poitiers, Angoulême, Bordeaux (St. Jean), and Dax—at 19·41 p.m., a total of 9 hours 1 minute.

The distance between Paris and Bayonne is 786 kiloms., or, say, 488·4 miles, so that the average speed for the entire journey, *stops included*, works out at very nearly 54·17 miles per hour. The duration of the stop at Paris (Austerlitz) is not specified in the time tables, but deducting the booked stoppage times at the other six places—a total of 33 minutes—the average running speed is found to be 57·68 miles per hour.

Between Bordeaux and Dax, a distance of 147·5 kiloms., or say, 91·66 miles, which is covered in 1 hour 29 minutes, the average speed is just over 61¾ miles per hour.

ANDRE BOURBON.

Rédacteur technique à la "Petite Gironde,"
Bordeaux, August 1st.

THE CHANNEL AEROPLANE DISASTER.

SIR,—Your leading article, published under the above heading in the issue of July 19th, calls for some comment.

The writer has no explanation to offer for the failure of the big end studs, but he is quite unable to see the logic of your remarks about the addition of the inertia stress to that due to the tightness of the nuts.

If the nuts were tightened just sufficiently to bring the halves of the big end together and no more, then obviously the stress would be due to inertia only, and each time the piston of the middle bank of cylinders reached its T D C, the stress would be at its maximum and the studs would stretch elastically, allowing the bottom half of the big end to separate from the top half by the amount of stretch. If the nuts are tightened up sufficiently to prevent this separation (*i.e.*, tightened to the inertia load) they will be in state of stress when the engine is not running. Since the nuts are tightened to prevent separation when running, the studs will have the same length when the engine is running as when stationary, and therefore the same stress. In other words, the effect of applying an initial stress equal to that due to inertia, is not to double the stress when running, but to transform the stress from a varying one to a steady one.

No doubt there is a considerable torsional stress on the stud due to the friction of the nut when tightening, but again this is a steady stress. In view of the above it is difficult to see why the studs should fail by fatigue if the nuts are tightened correctly.

Probably this rather theoretical steady stress is modified to some extent by the compressibility of the big end cap bosses and the elasticity of the cap itself, but it serves to explain my inability to agree with your conception of the addition of stresses. Of course, if the nut is tightened so much that the stud stretches plastically, anything may happen when using alloy steel studs with no stretching pieces.

It is interesting to note that the engine used in the machine which won the last Schneider contest ran at 3300 r.p.m. as against the 2350 r.p.m. of the engine which failed; the engine used in the Schneider contest had shorter connecting-rods, giving a more violent piston acceleration, and, according to published drawings, appears to have used an identical big end assembly.

R. C. MCLEOD.

Bedford, August 3rd.

Reconstructing a Railway Bridge in India.*

By C. I. STABLER.

As this paper deals primarily with the salvage and reconstruction of this bridge, it is perhaps unnecessary to go into details concerning its actual wash away. Suffice it to say that on September 19th, 1926, the river rose to the unprecedented reduced level of 1282 at the bridge site, as against the previous highest known reduced level of 1262ft. above sea level.

The bridge consists of five 200ft. spans, and one 150ft. span, all of the Whipple Murphy type, being 17ft. over all in depth. The water rose about 1ft. 6in. over the tops of the top booms, and when it subsided, it was found that all the spans had disappeared except one 200ft. span on the Gondia side of the river. By October 18th the water had fallen considerably and all the wrecked spans were visible. Fig. 1 shows their respective positions as they lay in the river bed, and the fact that one span weighing over 250 tons had been carried nearly half a mile downstream testifies to the great force of the current. . . .

The damage sustained by the spans was in many instances interesting and curious. The most remarkable feature was the paucity of sheared riveted connections. In almost every case the steelwork of the various members had been bent and torn, while the rivets in the connections were intact. All rivets were of steel, $\frac{7}{8}$in. diameter, except in the decking, where they were $\frac{3}{4}$in. diameter. Field rivets had been put in by pneumatic hammers. All the spans except No. 6—150ft.—had been rolled along the bed of the river before coming to rest. Thus the light overhead bracing and arching had suffered the greatest damage, while the heavy flooring, consisting of $\frac{3}{4}$in. deck plates, laid over 10in. by 6in. rail girders and 17in. deep cross girders, had withstood the excessive strain extraordinarily well in all cases. So marked was this in the case of No. 4 span, which had been rolled farthest downstream, that, whereas the flooring was practically undamaged, the wind and portal bracing had collapsed to such an extent that the two top booms were actually touching each other at one point. Hence the top booms of all the spans suffered more than the bottom booms. Indeed, several pieces of the latter had suffered so little that they might have been put back into position without any work being done on them, except that in the process of rolling along the boulders forming the river bed the edges of the flange plates had been very badly frayed and cut.

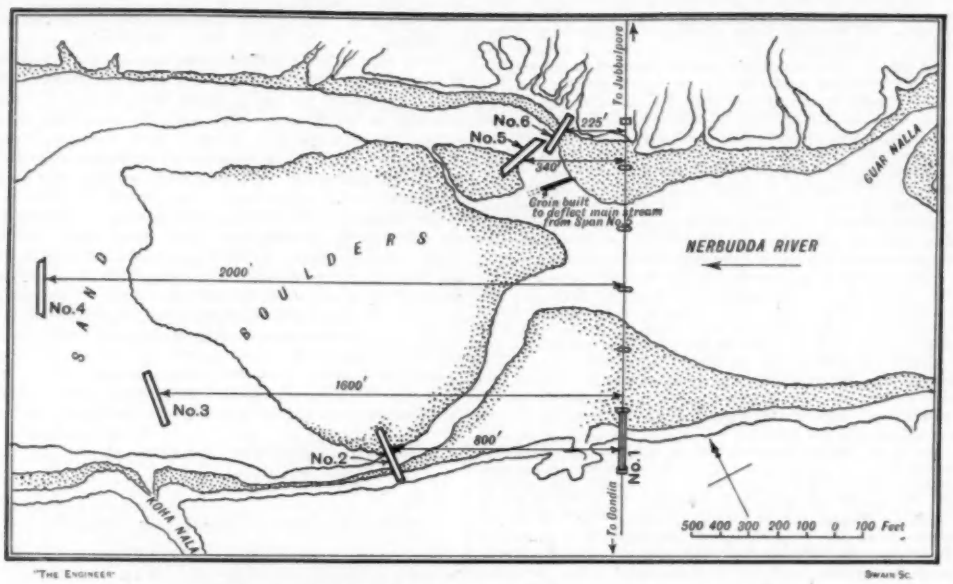

FIG. 1—PLAN SHOWING POSITIONS OF DISLODGED SPANS OF BRIDGE

After a careful examination of all the spans, the Chief Engineer decided to salve, cut up and recondition spans 2, 5, and 6. As much as possible of spans 3 and 4 was to be salved, but as these spans were considered to be damaged beyond repair, it was decided to replace them with two new spans from England. It was also decided to raise the height of the piers 20ft., in order to ensure that the girders would be well clear of the water, should a repetition of such a remarkably high flood take place. Arrangements were at once made to construct a pontoon bridge to enable passengers to be transhipped until such time as through running could be resumed by means of a diversion and pile bridge. The pontoon bridge was 900ft. long, and it was opened to traffic on November 14th, or only twenty-seven days after the decision to build it had been arrived at. The pontoons consisted of six 45-gallon oil drums fixed in timber frames, as shown in Fig. 2. There were sixty pontoons spaced 15ft. apart, centre to centre. The decking consisted of bamboo "challis," covered with gunny bags loosely filled with sand. The sand filling was found to be unsatisfactory, as it had a tendency to become pressed out towards the sides of the decking, and also wore away the bags very quickly. Straw filling was afterwards tried with much better results.

While the time taken to complete this pontoon bridge is possibly not a record, when compared with some of the achievements of the Great War, the speed at which it was designed, built, transported—including transhipment—and erected, must rank high amongst the engineering efforts of India. The diversion was 8000ft. long, with a ruling gradient of 1 in 35. The pile bridge consisted of thirteen 40ft. spans during the season 1926–27, but was extended by two 20ft. and two 30ft. spans for the following season. The girders were carried on timber pile piers.

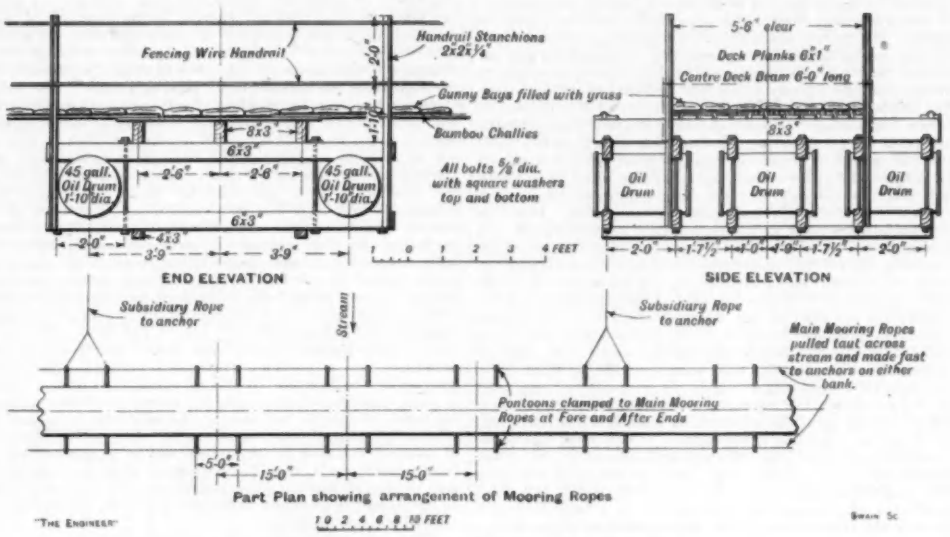

FIG. 2—ARRANGEMENT OF TEMPORARY PONTOON BRIDGE

The pile driving was done first with a 15-cwt. drop tup operated by a steam winch, but afterwards with a steam pile hammer fed by a Cochran boiler. The pile-driving pontoon, consisting of 130 oil drums yoked into a timber frame, was built at site. It was a successful pontoon, in so much as it only drew 2ft. 4in. of water under full load, but it rolled so badly under the action of the drop tup that heavy bullie legs, fitted with palms, had to be lashed vertically to the fore end. Thus the pontoon actually stood on the bottom while a pile was being driven. Five of the pile piers on the Gondia side of the river stood in water too shallow to float the pontoon, and these piles were driven from a pile frame mounted on a form of gantry track, supported on sleeper cribs. By means of this arrangement, the piles could be very accurately sited, and the frame moved rapidly from place to place. As many as twenty piles were driven in one day.

The Gondia bank of the river consists of sand, while the bed on the right bank, where the current is strongest, is of boulders. On the former side, piles were driven to 15ft. penetration with ease, while an average of 9ft. 6in. was all that could be obtained on the latter side. It is a remarkable fact that the piles having 15ft. penetration were washed out on two successive occasions, although no scour took place in their vicinity. The piles having 9ft. 6in., and less, penetration are still standing, thus leading one to the conclusion that the ability of a pile to withstand displacement depends more on the nature of the bed than on the amount of penetration. In order to facilitate the erection of the 40ft. and 20ft. girders, a special rocker crane mounted on a bogie truck was designed and built for the purpose from scrap material at site. This is shown in Fig. 3.

Each span was erected and sleepered and the rails laid on the bank, and by means of the crane, the complete spans were lifted, carried out, and placed in position intact. Thus the fifteen girders were erected, sleepers laid, and the line linked in four days. They were afterwards similarly dismantled in two days.

Meanwhile the salvage of the wrecked spans was progressing. In this work many unexpected difficulties were met with. No. 2 span, for instance, was very thickly matted with a great quantity of brushwood and tree trunks, and the removal of this *débris* by means of axes and hand saws was a very slow and tedious process It is considered possible that, but for this floating *débris*, the whole bridge might have withstood the flood, as actually happened in the case of No. 1 span, which was topped by the flood to the same extent as the others, but on which, owing to its position, no *débris* accumulated. While cutting up the broken spans, several men received minor injuries by their neglecting to bolt up a member before cutting the last rivet, thus allowing the strained members to spring violently apart when suddenly released.

Nos. 2, 3, and 4 spans were deeply buried in sand, and when an effort was made to remove this, water was met with at a depth of 2ft. 6in., and it was found impossible to keep the excavations dry. These spans were therefore jacked out of the sand by timber and rail clusters placed through the bracings, the sand being removed as the spans rose. Four 100-ton jacks were necessary on each span.

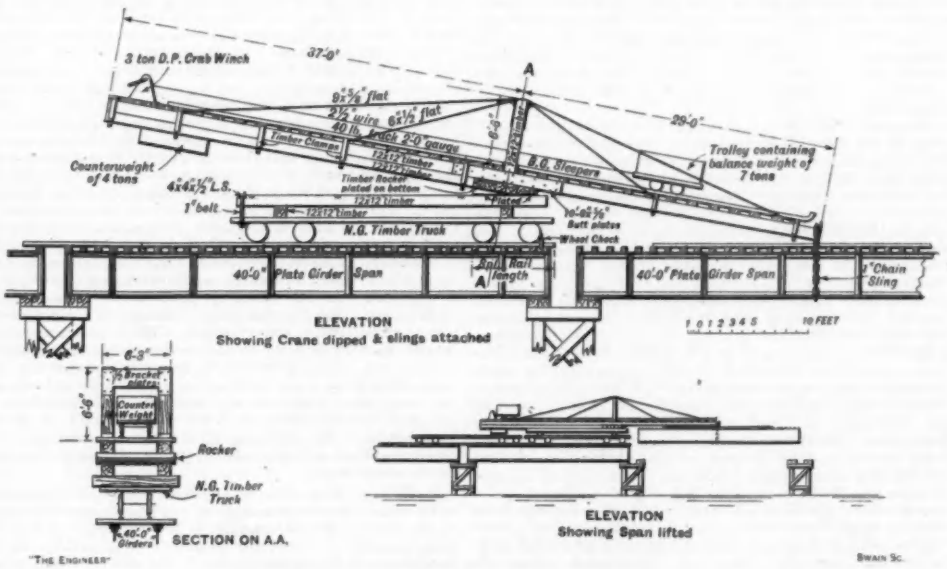

FIG. 3—ROCKER CRANE FOR ERECTING GIRDERS

* A paper entitled "The Reconstruction of the 2ft. 6in. Gauge Bridge Across the Nerbudda River, Bengal-Nagpur Railway," presented to the Institution of Engineers (India). Slightly abridged.

The difficulty with this arrangement was to prevent the men creating further damage by excessive straining on the jacks.

A curious instance of this was encountered in the case of No. 6 span. In this case the span had simply been pushed off the piers, and had landed right side up, with one end resting on the bank, and the other in about 16ft. of water. The span lay at an angle of about 30 deg., and was remarkably little damaged. The land end was first dismantled, leaving a portion weighing 50 to 60 tons in the water. Boulder piers were built along each side of this, and an attempt made to jack it from the piers by means of a beam consisting of two 16in. by 16in. timbers. Two 50-ton jacks, however, failed to raise the span, and finally two 150-ton and four 100-ton jacks were tried. These broke the timbers, but failed to raise the span.

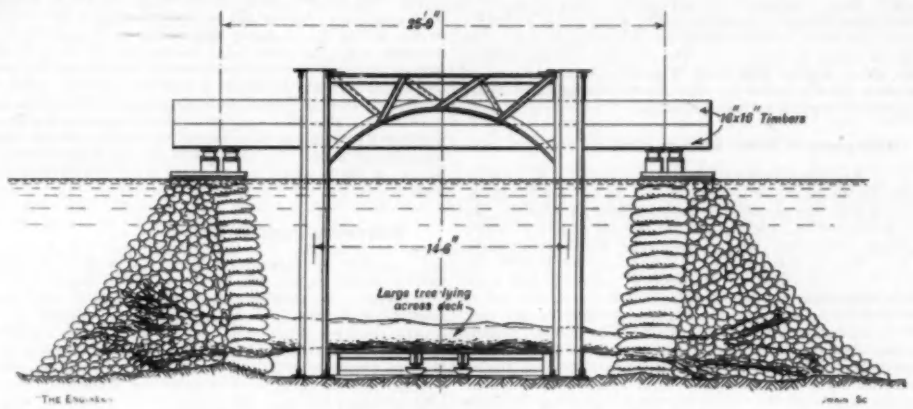

FIG. 4—TREE TRUNK PREVENTING RAISING OF SPAN

The water at this point was flowing at a speed of 8 miles per hour, and it was at considerable risk that a diver finally went down to investigate. It was then found that a very large tree had, in some extraordinary manner, passed through the bracings of the girders, precisely in the manner of the jacking beams. The ends of the tree had been unknowingly covered by the boulder piers on which were the jacks, as shown in Fig. 4. Hence we were, in effect, trying to lift ourselves like the man who placed a foot in each of two buckets and tried to lift himself. The upstream boulder pier had therefore to be extended in order to protect the divers, two of whom then went down and cut the tree with hand saws.

The most difficult span to salve was No. 5. This span had fallen on its side athwart the current, which here also flowed at 8 miles per hour. The span lay at a small angle, one half of the underside girder being submerged. It was obvious that the first thing to do was to reduce the current flowing against the span, and for this purpose a groin of boulders was built out from the bank upstream of the span. The position of the groin is indicated in Fig. 1. It was soon found, however, that boulders dumped off the end of the groin were being carried away, and were probably being banked against the span. The only effect of the groin had been to concentrate the current as in a nozzle.

The remedy appeared to completely divert the stream by converting the groin into a dam. No more boulders were available from that side on which the groin had been built, so the dam was commenced from the other side, boulders being taken from the channel into which it was intended to divert the stream. As the new groin approached the old, it was found that the boulders were being carried away. Gunny bags were therefore filled with boulders and dumped, and when these also began to carry away, the filled bags were tied together with wire. Eventually, when the gap had been reduced to about 15ft., it was found that as many as seven bags tied together were carried away before they reached the bottom. By this time the water stood 2ft. 9in. higher on the upstream than on the downstream side of the dam, and the water roared through the gap with a velocity which left little hope of it ever being closed.

The following arrangements, however, were made:—First, three 30ft. rails were laid across the gap, in the manner of a bridge. Two wires, whose lengths were approximately equal to the length of the cross-sectional outline of the dam, were then made fast at each end of the rails. The centre rail was tied at the centre of the wire, and the outer rails to the ends of the wire. The length of the downstream slope of the dam being known, a number of wires of this length were then tied to the downstream and the centre rail, at a distance of 1ft. apart for the full length of the rails. This done, the upstream rail was pushed overboard, and allowed to roll down the slopes of the dam, when the downstream rail was also pushed into the water. The wires connecting the downstream and centre rails immediately tightened up, thus forming a grid of taut wires all across the gap, as shown in Fig. 5. Bags of boulders were then rapidly thrown into the gap. These were held up by the wires on the downstream side, and eventually the gap was thus closed. The span now lay in dead water, and its salvage was taken in hand.

This was accomplished by placing a pair of the old bearings from the piers under the span at the centre, and pulling down the high end by means of winches until the submerged end rose clear of the water. The whole weight of the span was thus carried on the bearings, which acted as a fulcrum, at which points the boom pieces were badly crumpled. This sacrifice was considered worth while, however, in view of the expensive piling and timbering, and loss of time which would have otherwise been necessary to lift the span out of the water.

Each part of each span was marked as it was cut out, and each span was marked with a distinctive colour. This marking was very troublesome, since the spans had apparently been built before the designing of details became a fine art. In each span there were over 200 small packing pieces of all shapes and thicknesses, none of which were interchangeable, and all of which had to be marked.

Incidentally, this bad detailing was the cause of considerable trouble in the re-erection of the spans. For instance, each panel point contained rivets which passed through the cross girder cleats, two diagonals, one packing the boom plates and the post flanges. There were also countersunk rivets which passed through the post and boom plates only which had to be put in before the diagonals and packings, &c., could be erected. The objection to putting in rivets before a span is completely erected is well known.

An attempt was made to use pneumatic rivet busters in the dismantling of the spans, but although these machines did excellent service in cutting up individual pieces after they had been lowered to the ground, they were found to be much too heavy and unwieldy for use on the flimsy and unsteady scaffolding.

While the salvage work was in progress, the masonry

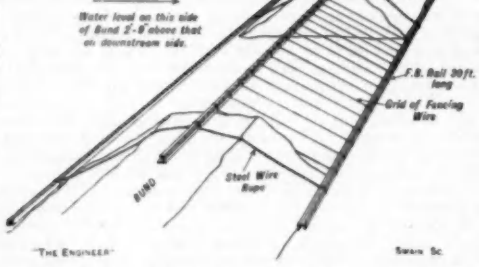
Water level on this side of Bund 2'-0" above that on downstream side.
BUND
Steel Wire Rope
F.B. Rail 30ft. long
Grid of Fencing Wire
Steel Wire Rope
BUND

FIG. 5—ARRANGEMENT OF RAILS AND WIRES

work necessary to raise the piers 20ft. was being carried out. The old copings and the remains of the old bed stones were dismantled. The latter were sandstone blocks from a quarry in Jubbulpore, and it is perhaps worth mentioning that most of them were found to have weathered and deteriorated to a somewhat alarming extent. The masonry in the extensions of the piers consisted of black granite, quarried locally, laid in cement mortar of the proportions of 1 cement to 5 sand.

The cement used was of Indian manufacture, and proved most satisfactory throughout. Indian cement was also used in the reinforced copings and bed blocks, and so satisfactory were the results obtained in all cases that the prejudice in which Indian cement is sometimes held is difficult to understand. As an instance of the good quality of the cement used, a temporary foundation for a staging was built in the river bed. It was built of random rubble stone in cement mortar, one to 5. Six months afterwards it was necessary to dismantle this foundation, and it was then found that, so hard had the cement become, the stones were broken much more frequently than the joints in the process of demolition.

The workmen and materials were carried out to the piers from the bank by means of an aerial ropeway. Except for the steam winch by which it was operated, the entire ropeway was manufactured from scrap material at the site. It extended from bank to bank, and was supported on each pier. It required considerable persuasion and much jocular conversation to induce the first man to go out in the cradle, but so powerful is the moral effect of familiarity, that eventually sentries had to be posted at each end of the bridge in order to prevent more than four men climbing into the cradle at one time.

Water for the masonry was carried by means of 1¼in. pipe slung on hooks suspended on a 2½in. wire stretched across the tops of the ropeway trestles. The air valves which were necessary in the pipe line at every trestle were manufactured from standard pipe fittings and small india-rubber balls purchased locally.

No. 1 span—the only one not washed off the piers—was jacked up 3ft. 6in. at a time as the masonry on the abutment and pier No. 1 proceeded. Four 100-ton hydraulic jacks were used for this work.

The original design of the falsework on which the reconditioned spans were built consisted, in the 150ft. span, of one 60ft. and one 80ft. broad-gauge plate girder span, supported at the centre by a staging, and, in the 200ft. spans, one 33ft. span in the centre supported on two stagings, with an 80ft. span on either side.

The plate girders were braced with timber, and carried 12 by 12 and 8 by 12 timbers, 35ft. long laid athwart on top for the decking, camber jacks, and gantries. Steel stagings strengthened with timber were erected in spans 5 and 6, and two steel stagings were manufactured out of old cross girders, rail bearers and boom angles for supporting the plate girders in span No. 4. These stagings were 70ft. high to the underside of the plate spans, and carried a maximum of 190 tons each.

On the completion of Nos. 4, 5, and 6 spans, the dismantling of the falsework was effected by suspending the plate girders to the bottom booms of the main girders. The stagings were then dismantled, and the plate girders afterwards lowered by means of tackle lashed to the main girders. The staging foundations in No. 4 span consisted of a steel grill carried on bullie piles, and in Nos. 5 and 6 spans, the foundations were of concrete.

The type of timber and plate girder falsework described above was, however, found to be much too heavy, and took too much time to erect. For the remaining two spans, therefore, new falsework was designed. This consisted of light angle steel posts in 16ft. lengths, extending all across the span. In each span there were 108 posts, each built up of four 3 by 3 by ¼ angles bolted together, and braced with 3 by 3 by ¼ angles. This staging consisted of three types of members only, and was very easily and quickly erected.

The camber jacks used were obtained from the Eastern Bengal Railway, from the surplus stock of the famous Lower Ganges—or Hardinge—Bridge at Sara. They were used in pairs, one pair on each side of each joint. In order to prevent them creeping when they were operated, they were coupled together in pairs by means of a plate, and to prevent the plate fouling the rivets, a ring was fitted on the top of each jack.

The actual erection of the main girders differed little from the erection of any other similar girders. The new spans from England went together with the greatest ease, but in the case of the reconditioned spans the work was very seriously hampered by missing parts, which had to be manufactured at site.

Still greater delays were occasioned, however, by the fact that many members, particularly tension members, had lengthened considerably in the process of being straightened. This defect was corrected by cutting out a strip equal in width to the excess length of the member, and rejointing with suitable plates.

All riveting, reamering, and drilling was done by pneumatic machinery, fed by two oil-driven air compressors, one at each end of a 2½in. pipe, which extended the full length of the bridge. With specially trained supervision,

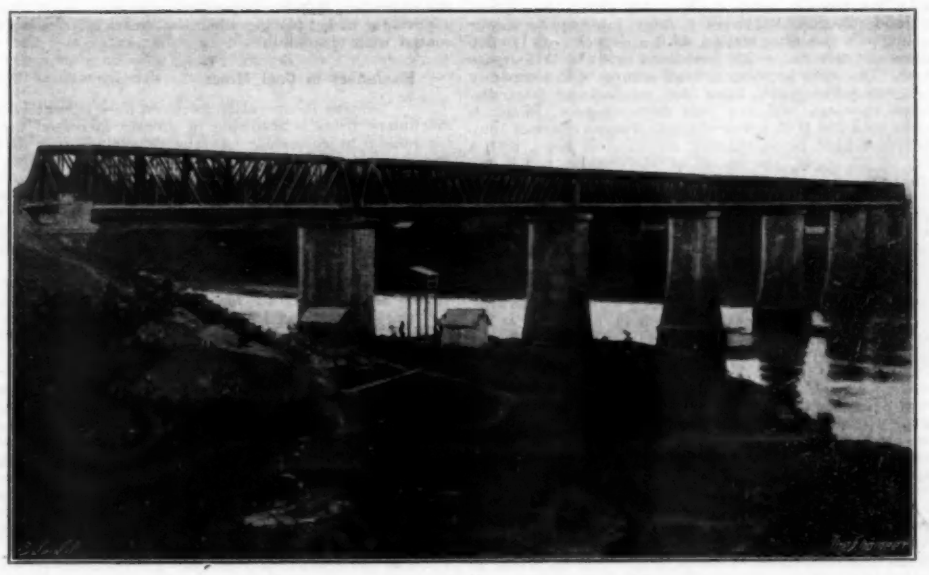

FIG. 6—THE RECONSTRUCTED NERBUDDA RIVER BRIDGE

and moderately new machines, the oil-driven air compressor might doubtless give satisfaction; but on work of this nature the ideal conditions necessary are seldom, if ever obtained, and steam plant, which will plod along under almost any conditions and the worst usage, is undoubtedly preferable.

It is a tribute to the firm which manufactured the old spans that the corresponding parts of all girders were interchangeable. This was particularly fortunate in the case of Nos. 2 and 3 spans. Owing to a strike in the Engineering Works at Calcutta, where the old spans were being reconditioned, material ceased to arrive. Parts of Nos. 2 and 3 spans, which were on hand, were therefore amalgamated, and worked in to form a complete span for No. 2. The remaining material was augmented with parts taken from the two abandoned spans, and No. 3 span was thus completed. The parts taken from the abandoned spans were repaired and straightened at site.

The riveting up of the last span was completed at six o'clock on the morning of July 7th, the men working right through from six o'clock the previous morning without a break—a performance which surely places Indian labour in a class which compares well with that of any other country. Their efforts undoubtedly saved the B.N. Railway Company a considerable sum of money, for the river began to rise very shortly afterwards, and the last few pieces of staging were removed with the men working knee-deep in a rising flood.

The floods having started, the bridge could not be tested by the ordinary means. Wooden hangers supported on tight wires running the full length of the bridge and supported on each pier clear of the girders were therefore devised. These worked very satisfactorily. The maximum deflection registered under the speed test, consisting of two engines coupled head to head, running at 30 miles per hour, was 0·85in., with 0·25in. oscillation.

Fig. 6 shows the completed bridge, the work having been carried out in nineteen months from the date of starting the dismantling of the wrecked spans.

American Engineering News.

Hot-blast Cupola.

At the Michigan City works of the Pullman Company a single hot-blast cupola has replaced two cold-blast cupolas and gives better results. The old cupolas had 8ft. shells lined to an inside diameter of 5½ft., and together required twenty-eight men for a combined daily output of 260 tons. The new one has a 10ft. shell lined to a diameter of 7ft., which may be changed to 8ft. if necessary, and with a force of twelve men it has a capacity of 250 tons in an eight-hour shift. When the metal has been brought up to the desired temperature, the heat can be maintained with a blast pressure as low as 1 oz. The blast fan is driven by a 50 H.P. motor, and gives a pressure of 7 oz. to 9 oz. at the cupola, as compared with 12 oz. to 14 oz. with the former cold blast. It enters through twelve tuyeres, 10in. square. Gas leaving the cupola at 1400 deg. Fah. is raised to 1700 deg. in the combustion chamber, and passes up through the tubes of the blast heater, in which its temperature is reduced to about 600 deg. Air entering the heater at atmospheric temperature is delivered to the cupola at 450 deg. to 500 deg. The iron charge consists of pieces of old wagon wheels which fall from a breaker on to a conveyor that loads a charging buggy standing on a scale. When the car has the proper weight, the drop of the scale releases a compressed air "kicker," which causes the buggy to run on to the platform of the charging skip, the skip automatically discharging its load into the cupola.

Large Electric Pumping Plant.

To handle the combined sewage and storm water flow from an area of about 420 acres, the City of Portland, Oregon, has built a large intercepting sewer leading to a pumping station with a capacity of 110,000 gallons per minute, which discharges into the Willamette River. The three large centrifugal pumps, with a capacity of 30,000 gallons each, have 36in. suction and 30in. discharge openings and can pass 24in. spheres. Each is driven by a 250 H.P. motor through a silent chain of 16in. width and 1½in. pitch, running on cut steel gears, with a ratio of 27 to 43, the speed of the motor being 388 revolutions and that of the pump 243. Two smaller pumps with capacities of 10,000 gallons per minute have 20in. suction and 18in. discharge, and can pass 15½in. spheres Each pump is driven from a 100 H.P. motor by a silent chain on gears of 19 to 72 ratio, the speeds being 882 revolutions for the motor and 232 for the pump. Each intake opening in the pump-house wall is fitted with a gate valve, and each discharge opening with a check valve, the discharge lines increasing from 30in. and 18in. at the pumps to 52in. and 42in. respectively at the outfall end. Three-phase 440-volt current is used, power being delivered at 11,000 volts by two independent transmission lines in order to ensure operation at all times. Formerly each sewer discharged directly into the river, and in times of high water there was considerable flooding. Now the river is restrained by a concrete wall and all sewage and storm water goes to the pumping station, where it is discharged into the river.

Alloy Steels for Turbines.

While various metals and alloys have been tried for the blades of steam turbines, only a few are found to give satisfactory results under the high temperatures and working stresses of modern machines, especially as some of the otherwise good alloys will not stand the process work involved in the manufacture of the blades. In this respect nickel alloys have an advantage in that they lend themselves to this processing. Failures due to vibration, which are the most common, occur mainly in stainless steel, while those due to corrosion and erosion occur particularly in ferrous alloys. Hydrogen and other extraneous gases in the steam cause both corrosion and embrittlement, this last defect being caused also by vibration. A curious defect in earlier machines was the growth or lengthening of cast iron casings, which was due to the effect of extraneous gases in the steam, but this trouble has been eliminated by the general substitution of cast steel for cast iron. The same effect may be developed in cast iron blade rings, causing distortion which may eventually lead to contact or rubbing of the blades, with consequent failure. At present, stainless steel and also nickel-chromium steel are largely used for blading, with plain nickel steel in the last-stage wheels of large turbines, where strength to resist mechanical stress is more important than resistance to corrosion. According to a recent report, there is as yet no really dependable metal for blades, and when failure occurs the reblading is done with material which also may fail. The problem is being studied from many angles, but until it is solved the owners of operating plants must provide reserve capacity in order to maintain service in case of failure.

High-pressure Power Stations.

Five large generating stations working at 1400 lb. boiler pressure are in operation or under construction. There is also one at 1300 lb. and another at 1200 lb., the next being 800 lb., while there are several at 650 lb. down to 400 lb. pressure. The station now under constructon on the Delaware River for the New Jersey Power and Light Company will be of 220,000-kW capacity, but when put in operation in 1930 it will only have the first of its four 55,000 cross-compound turbo-generator units, with two horizontal water-tube boilers. The South Amboy station, also under construction, will have an ultimate capacity of 250,000 kW. but will start with two turbo-generator units of 25,000 kW and three boilers. Comparative estimates were made for plant operating economy at 450 lb., 770 lb., and 1400 lb. boiler pressure, the last showing a sufficient advantage to warrant its adoption. Each boiler has 7214 square feet of heating surface, but with its superheater, reheaters, and economiser, the total heating surface is 64,980 square feet. Pulverised coal will be fed to five burners, using a combustion control system which will proportion the coal and air supply at each burner. An unusual arrangement of the turbo-generators which greatly reduces the floor area required, is that the high-pressure turbine and its generator are mounted upon the low-pressure generator. This turbine runs at 3600 revolutions and its generator is of 5700-kW capacity, while the low-pressure turbine runs at 1800 revolutions and its generator has a capacity of 19,300 kW. Three-phase 60-cycle current at 13,200 volts is generated.

Electro-chemical Treatments.

A number of special treatments for plating steel are in regular or experimental use, including electro-plating with cadmium and chromium, especially for bolts and machine parts to prevent rusting. These are used in automobile, airship, and submarine boat construction. Zinc plating of automobile wheel rims has improved under technical control, and is now done in two operations, both of which employ cyanide zinc-plating baths and zinc-mercury anodes. A demand for black finished rims led to trials of the antimony black method and lacquering the zinc-plated rims in order to meet the demand promptly. Experiments were carried on with coatings of the acid-phosphate type, but one process was much too slow for commercial use unless the rims were first heavily etched with acid. However, a manganese-phosphate solution was developed which did not require the etching and gave a better coating in a short time. The operations are handled automatically, the rims being placed on a conveyor and passed through all the processes, including enamelling, and then discharged from the conveyor at the shipping platform. Failure to get high resistance to salt spray tests on plated steels has been traced to surface defect in the steel, so that better results have been obtained by polishing the steel before plating instead of simply applying a heavier plating. However, the cost of polishing was very high and attention was given to securing a better grade of steel. Bright dipping has been found greatly to increase the adherence of metal deposited, as in the case of copper deposit for nickel plating when the nickel is to be heavily coated with chromium.

Machinery in Coal Mines.

Active co-operation between mine operators and machinery firms is resulting in greatly increased use of machinery in collieries. At the recent meeting of the American Mining Congress there was presented a review of loading conditions in 100 mines in various parts of the country. Of them, 43 use mechanical loaders, 29 use conveyors, 17 have pit car loaders, and 11 use scrapers. The machines total 1045 and have a daily capacity for handling 90,000 tons. Three of the mines use mechanical loaders in coal less than 5ft. thick, these machines and the pit car loaders being preferred for thick beds of coal. The conveyors and scrapers are mainly used in seams less than 4ft. thick. Of these 100 mines, mechanical coal cutting is used in 98, mechanical drilling in 94, and mechanical haulage in 72. Increased safety results from mechanical loading, one large mine reporting one injury per 15,000 tons of coal loaded in this way, as against one per 4000 tons with hand loading. Another mine reported eight accidents per 100,000 tons with machine loading and twelve with hand loading. In twenty coal-producing States, during 1928, there were 14,559,000 tons loaded by machine and 7,900,000 tons by pit car loaders and hand-loaded coveyors, a total of 21,559,000 tons handled mechanically. Haulage of seven to ten miles in mines was reported by two mines, using 35-ton locomotives and 90 lb. rails. Loaders of the pit car type had a rapid development during 1928, and several types of machines were on exhibition at the meeting. Some of these stand on the mine track and others stand on the floor or can be used in either way.

Shore Protection.

The low sandy shores and swamp lands along the coast of the Gulf of Mexico are subject to continual change and erosion by storms, and with the development of seaside towns and pleasure resorts in this region it has been necessary to provide substantial revetment along the sea front. It is intended to have a continuous pleasure drive or highway in connection with this protective work, and at present there is a completed stretch of 36 miles. For about 24 miles there is a concrete wall, the sloping face of which is formed in a series of steps to break up the waves in time of storm. This wall is built on concrete piles, and behind it the low ground is filled by pumping in sand from the beach. Upon this filling is the concrete-paved road, behind which the filled ground is developed for residences, hotels, parks or other purposes. On the remainder of the work the construction is somewhat different. A line of concrete tongued and grooved sheet piling, 10ft. to 20ft. deep, is driven at the toe and capped with concrete. A sand fill or embankment is then formed in rear of this by pumping, and upon this is built a convex concrete wall, its lower edge resting on the line of sheet piling, 18in. below mean water level, and its top 7ft. above the water. It has a radius of 10ft. 6in. and its top is 9ft. back from the toe. The concrete is 24in. thick and heavily reinforced. The 30ft. concrete road is separated from the wall by a row of concrete blocks 9in. high and 5ft. apart, supporting a kerb or slab, this construction serving to break up waves which may run up to the top of the curved wall.

Waterworks Pumping Plant.

For the new water supply system of St. Louis, taking water from the Missouri River instead of the Mississippi, the pumping station has a high-head plant consisting of two cross-compound steam turbines, each geared to two single-stage centrifugal pumps in series, the gear ratio being 7·54 for the high-pressure and 5·81 for the low-pressure unit. The capacity is 60 million gallons daily, with speeds of 4500 revolutions per minute for the high-pressure turbine, 3460 for the low-pressure, and 596 for the pumps. The head is 360ft. For the low-head service, with 40ft. head, there are three steam turbines, each geared to a single-stage centrifugal pump and having capacities of 120 million gallons daily. There are four cross-drum water-tube boilers of 6520 square feet heating surface, with a furnace volume of 0·4 cubic feet per square foot of heating surface. With 325 lb. boiler pressure and 245 deg. Fah. superheat the final steam temperature is about 670 deg. Motor-driven forced draught chain grates were adopted on the basis of experience at other stations. A convection superheater is placed over the tubes and a radiant superheater in the rear wall of the furnace. The condensers are of the type used at power plants, on account of the liability of tube condensers to be clogged with leaves and eroded by sand working past the screens. The average annual duty for the larger pumps, with 4460 H.P. at 50 million gallons daily against 336ft. head, is 164 foot-pounds per B.Th.U. Six high-head and four low-head pumping units will be the complete equipment. Two turbo-generator units for lighting and auxiliary power are supplemented by a standby plant consisting of a six-cylinder petrol engine and 90-kW generator.

Large Excavators.

Continual increase in the size and power of excavating machines is characteristic of this class of American machinery and reaches a high point in the enormous excavators used for handling iron ore and stripping coal beds. One of the latest designs handles a bucket of 20 cubic yards capacity on a jib 100ft. long, or a 15-yard bucket on a 120ft. boom. The height of bank which can be built is 50ft. with the larger and 70ft. with the smaller bucket. The underframe is a rectangular structure 45ft. square, with each corner mounted on a bogie or truck having two long crawler tractions instead of wheels. Four 8ft. plate girders forming the frame are connected by interior bracing and corner castings, and are so reinforced that the heavy load of the revolving superstructure carried by the rollers in the circular path of the turntable is transmitted to the lower booms of the girders without going through riveted connections. Each crawler belt or chain is 3ft. long and has a length of 17ft. 3in. in contact with the ground, so that the eight crawlers give a total bearing surface of 414 square feet. Alloy steel castings are used extensively, most of them containing a proportion of copper. This metal gives an elastic limit of 60,000 lb. to 78,000 lb. with an elongation of 22 to 26 per cent. in 2in. and a 30 per cent. reduction in area. High-manganese cast steel is used for parts subject to heavy wear, and most of the gearing is of cast steel, with shafts of chrome-vanadium steel. The revolving upper frame carries the machinery and plate girder boom, the head of which is attached to a luffing cable led back to a steel tower on this frame. The electric operating equipment includes six main motors, two of 450 H.P. and four of 150 H.P.

Manganese Steel for Arch Bridge.

For the steel arch bridge of 1675ft. span now being built to connect with Staten Island, in New York Harbour, a considerable portion of the material will be a medium manganese steel having 0·35 to 0·40 per cent. carbon, with manganese not exceeding 1·80 per cent. This gives 90,000 lb. per square inch as the lowest ultimate strength, 55,000 lb. yield point and 16 per cent. elongation in 8in. This to some extent supersedes the nickel steel of the same strength and yield point included in the original specifications and having 0·40 per cent. carbon, 1 per cent. manganese and 3·25 per cent. nickel. The cost is reduced by the elimination of nickel, easier rolling as compared with nickel steel, availability of crop ends as scrap, and the easier drilling, shearing, milling and flanging of the softer manganese steel. Physical tests are well above the minimum requirements of the specifications, and show a uniform quality, from which it is predicted that this grade of steel will have a wide development for structural purposes. For other purposes this manganese steel has already had an extensive application. It has been used also in plate girders. This bridge has two braced or trussed arch ribs 31ft. deep, with a rise of 266ft. from springing line and a headway of 150ft. from water surface to the roadway. The width is 74ft. between centres of ribs. Each arch has a 16in. steel pin 8ft. long as its bearing in the shoe at the springing. The arch span is estimated to cost about £1,330,000, while the total cost, including approaches, will be £3,600,000. It will carry a 40ft. roadway and footwalks and will be operated as a toll bridge until the bonds are redeemed by the sinking fund. In span the arch exceeds by 25ft. that of the bridge at Sydney, Australia.

Railway and Road Matters.

DURING the year ended March 31st, 1928, there were 45 passengers and 23 servants killed in train accidents on the railways of India, as compared with 16 passengers and 25 servants in the corresponding period of 1926–27. Of the 45 passengers killed in 1927–28 there were 37 who lost their lives in the malicious derailment on January 28th of the down mail on the Burma Railways. There were 323 servants killed in "movement" accidents as compared with 319 in 1926–27.

WE often have commented upon railway engineers becoming general managers of British railways, and, in the United States, reaching the rank of president. A yet more noteworthy illustration of the latter conditions is to be found in Mr. Charles E. Dennay, who was in the railway signalling profession, and was the signal engineer of the Lake Shore and Michigan Southern Railway, becoming first the vice-president for operation and general manager of the New York, Chicago and St. Louis, and now the president of the Erie Railway.

IT is stated that from October 1st Marlborough-road and St. John's Wood-road Stations on the Metropolitan Railway are to be closed up to 9.45 a.m. and after 5 p.m. These, and Swiss Cottage, are the three stations that come in the double line "bottleneck" between Baker-street and Finchley-road, and it is said that if those two stops were eliminated, twenty additional trains could be got through morning and evening. We would add that in 1926 the Metropolitan Railway received powers to construct a tube railway between Edgware-road and Willesden Green that would have avoided this "bottleneck."

IT is a strange thing, that, when railway communication, as regards the conveyance of passengers, is over 100 years old, it should be found that there are no means whereby a railway that has been opened for traffic can be abandoned, except by an Act of Parliament. This fact has been revealed by the application to appoint a receiver for the Southwold Railway—see this column of THE ENGINEER of April 19th. There are two Acts of Parliament for the abandonment of railways—13 & 14 Vic. c. 83 of 1850, and 32 & 33 Vic. c. 114 of 1867—but both provide only for the abandonment of what may be called schemes, and cover the sale of land and the return of monies advanced. Mr. Justice Maugham, in agreeing to the appointment of a receiver, said that he was afraid that that officer could not do much; he could not sell the statutory undertaking, nor the rolling stock or permanent way.

A FLEET of twenty large locomotives is being built for the Canadian Pacific Railway for use on the heavy gradients of the Rocky Mountain region, and one of these engines has been on exhibition at Montreal. Each engine and tender measures 98ft. in length overall, and weighs 750,000 lb. These engines were designed by the motive power department of the Canadian Pacific Railway, and were built to specifications at the Montreal Locomotive Works. An unusual feature is that the cylinders and under frame were cast in one solid piece, weighing in the neighbourhood of 67,000 lb. This great casting, which is normally made up of a number of massive sections bolted together, takes in the cylinders, main frames, cradle frames, and all cross ties, and thereby achieves far greater rigidity than is otherwise obtained. The tenders also embodied a similar casting embracing the bottom of the tank and underframe in one solid piece.

THE possibility that the new station on the south side of the Thames that is to replace Charing Cross Station would be combined with the existing Waterloo terminus, was disposed of by Brigadier-General Baring, when he addressed the extraordinary meeting of the proprietors of the Southern Railway on July 30th. He said that whilst that would be an excellent arrangement if it could be carried out, the directors found themselves up against so many technical and operating difficulties that they had to abandon the idea. The chairman's speech revealed some forgotten problems associated with Charing Cross that the provision of the new station will remove. That portion of the bridge which was opened in 1864 requires to be strengthened, and powers for that were obtained with much difficulty in 1917, but with the proviso that were the bridge removed within fifteen years as part of a public improvement, the company was not to be compensated for strengthening the bridge. The same Act prohibited any other improvement at Charing Cross, *e.g.*, rebuilding or improving the station or hotel. Lastly, the company is under a statutory obligation to keep open the forecourt at Charing Cross as an open public place, and so it could not be utilised for enlarging the station or hotel.

THE failure of a train to pull up when the passenger communication was pulled near Flint, on July 20th, was due to the driver assuming that the fall of the needle of his vacuum brake gauge was due to a leak, whereas it was the correct response to the pulling of the communication chain making a gradual application of the continuous brake. That arrangement, it may be of interest to state, was first introduced on the Manchester, Sheffield and Lincolnshire Railway in 1890, and was received with great relief by the railway companies and the Board of Trade. Some means of communication between passengers and the men in charge of the train had long been necessary and frequently demanded. In an Act, of which mention was made in the paragraph "Sixty Years Ago" which appeared in our issue of August 2nd, that was passed in 1868, the railways were ordered to provide such efficient means of communication "as the Board of Trade may approve" to all trains that ran 20 miles without stopping. The only means of communication that resulted generally was not "efficient"; it was the cord system introduced by T. E. Harrison of the North-Eastern Railway. John Bright was at the Board of Trade at the time, and though the inspecting officers opposed its introduction, the railways said it was a good system, so it was provisionally approved in February, 1869, and definitely sanctioned in August, 1869. It often failed and eventually, in 1873, the sanction was withdrawn. Except the electrical communication on a few lines the cord system remained in use until the M. S. and L. vacuum brake system was adopted by all the companies and sanctioned in 1899.

Notes and Memoranda.

ACCORDING to Mr. G. Brodsky, an addition of 2·5 per cent. of nickel to iron produces castings free from blowholes and sponginess, especially suitable for hydraulic machinery.

A BLAST was recently made in California in preparation for the construction of the San Gabriel dam. It involved the explosion of 90 tons of black powder, and resulted in the loosening of some 150,000 cubic yards of rock on a face about 400ft. high.

THE new Junkers heavy oil engine is said to have been used for an aeroplane flight of fifteen hours. It is of 850 horse-power and runs at 1300 revolutions per minute. The fuel consumption is said to be 25 per cent. less than that of a petrol engine of similar output.

AN ingenious system of lighting has been evolved in connection with the new Williamsburg Savings Bank Building in Brooklyn, New York. In the upper part of the building are fabricated louvres, which from the ground level give the appearance of a solid structure. In the darkness of night internal lamps illuminate the structure by reflection from the gilded surfaces of the louvres.

AFTER much investigation and experimental work, Beecroft and Partners, Ltd., of Sheffield, have evolved a process for the production of high-duty cast iron, to which they have given the name "B I C." This process is one which involves no expensive plant, and necessitates only slight alteration to the existing copula, while at the same time it does not interfere with the production of ordinary cast iron from the same copula. The proprietors of the "B I C" process state that several foundries which have adopted the process are making high-duty cast iron from which they are obtaining tensile strengths from 16 to 20 tons per square inch.

IF the blast-furnace was never called upon to do more than reduce iron from its oxide with the use of fairly pure fuel, its economy would be self-evident, but when more is required of it, fuel economy at once falls, according to Mr. H. E. Wright. The reason is that, except hot blast, nothing enters the furnace which does not carry heat from it, and to provide that heat necessitates fuel combustion. The complete combustion of carbon or fuel in a blast-furnace is practically wholly dependent upon reactions connected with iron and iron reduction. Therefore, beyond that combustion its effective use of fuel falls because there exists no possibility of fully burning it. However, a saving clause is that in consequence more potential heat exists in the gases.

THE most outstanding property of the beryllium alloys is in their improvement upon heat treatment. A copper-beryllium alloy containing 2·39 per cent. of beryllium, after ordinary quenching, has a Brinell hardness of 100 kilos. per square millimetre, but after heat treatment for seventeen hours at 300 deg. Cent., this rises to 440 kilos. per square millimetre, that is, to over 400 per cent. Some copper alloys containing over 6 per cent. beryllium have a Brinell hardness number of over 730. These alloys cannot be worked in the untreated condition. Bronze-like properties are developed in these copper alloys, which in the untreated condition can be rolled, drawn, or worked to the desired shape, and then by heat treatment can be hardened and toughened. It is possible to make thin elastic pieces.

THE Bermuda Islands, being composed almost entirely of coral and limestone rock, provide, says the *Engineering News-Record*, a paradise for the road-maintenance gang. When a hole appears in the road it is merely necessary to scarify it with a pick, loosen a small amount of rock from the side of the road, place the loosened rock in the hole with a little water and tamp it into place. After tamping, the patch is sprinkled with water and a small lawn roller drawn over it, and the road is ready to receive traffic. The fact that the horse-drawn vehicle is the principal mode of transportation, there being only six automobiles on the islands, makes possible this ideal patching method. If automobiles were used to a greater extent, it would be necessary to construct a more durable road than the natural rock.

THE 322ft. lift span of the Newark Bay Bridge, U.S.A., has been safely salved and been put in place. It was thrown off its falsework by a heavy gale early this year. In recounting the salvage the *Engineering News-Record* says that, while steel work of the span was found to be practically undamaged, every member was completely covered with barnacles, accumulated during the two months' submersion. Removing these barnacles proved to be very difficult, especially on the inside of the box members. The use of grinding machines fitted with stiff rotary wire brushes proved to be only partly successful. Hand scraping was found to be slow and tedious and on the whole unsatisfactory. The most effective method of removing these barnacles was by using long-handled scrubbing brushes with fresh water, caustic soda and washing powder.

IN his comments on the destruction of a valve chest in the auxiliary piping arrangement of a 6000-ton vessel, equipped with three Scotch boilers, the Engineer-Surveyor-in-Chief, Board of Trade, makes the following remarks:—"The arrangement of the auxiliary steam pipes was such that when any one of the three boilers was used separately for supplying steam to the auxiliary range, there would be no flow of steam in one section, either on the port or starboard side, according to which boiler was in use. Very little fall was provided in the lead of the pipes, and consequently any list to the side away from the boiler in use would cause condensed steam to collect and conditions favourable to water-hammer action would be set up. A drain cock would not be effective in such a case unless set to drain continuously any water that might collect, or, alternatively, fitted with an efficient automatic steam trap. This is the second explosion that has taken place on board this vessel due to water-hammer action, but now that shut-off valves have been fitted to isolate sections of the pipe line not in use, and provided each section is drained before the isolating valve leading to that section is opened, a repetition of the conditions which led to the explosion is improbable."

Miscellanea.

IT is proposed to abolish level crossings in Hull, at a cost of £1,250,000.

IT cost £24,372 to maintain Tower Bridge last year. The bascules were lifted 5537 times.

THE new flotilla leader "La Rioza," for the Argentine Navy, built by J. Samuel White and Co., of Cowes, attained a speed of 39·4 knots during her official trials.

DURING the past twelve months, which were the third year of its existence, the Delaware River bridge between Philadelphia and Camden was crossed by 10,688,820 vehicles.

THE Alpine railway line from Visp to Zermatt, in Canton Valais, which was built in 1889–90, has been electrified. The electric power is supplied by the Swiss Federal Railways.

THE cement despatched by all the companies, members of the Concrete Association of India, manufacturing cement in India, during the month of May amounted to 52,616 tons.

THE Hull Corporation proposes to purchase the Queen's Dock from the North-Eastern Railway with the object of filling it in and utilising the space for business purposes or for a boulevard.

THE new bridge, built by the Corporation of Glasgow, over the river Kelvin is to be opened to-day. It has a span of 135ft., and will provide an important link in the connection of the dockland traffic of Glasgow.

THE equipment of the new Norwegian whaling vessel "Kosmos," of 23,000 tons, includes a Moth light aeroplane. The machine is to be used for scouting for whales and for finding passages through the ice of the Antarctic.

THE 300ft. lift span for the San Mateo-Hayward Bridge at San Francisco, has been safely moved on two barges from its place of assembly to its final site. The voyage of the structure was a matter of eight miles, and was accomplished with the aid of three tugs.

CANADIAN automobile registrations reached the million mark in 1928, according to the Dominion Bureau of Statistics, with an aggregate of 1,076,819 cars—921,395 passenger and 155,424 trucks, omnibuses and motor cycles. There is now one motor vehicle for every nine persons in Canada.

A NEW bridge is to be built across the Ohio River at Pittsburg. It will be 1·1 miles long, with 63·36ft. vertical clearance at the channel piers, and 72·72ft. vertical clearance for 250ft. in the centre of the stream, thus permitting safe navigation at all river stages. It will cost 3,540,000 dollars.

A NEW wharf constructed by the Leith Dock Commission in the Outer Harbour of Leith was formally put in use on the 1st inst. It is built of concrete on what was practically waste ground, is 1000ft. long, and has three or four berths with deep water alongside, making shipping independent of locks.

THE Trustees of the Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1929–30 to Mr. Stanley George Hooker, B.Sc., A.R.C.S., of the Royal College of Science, London.

ONE of the recently erected buildings in America, that of the McGraw Company in Chicago, is supported by composite columns of cast iron and concrete. The exterior dimensions of the columns remain uniform throughout the sixteen storeys, and are generally 24in. by 24in. The circular cast iron core ranges from 11in. in diameter at the basement to 3in. in the top storeys.

A NEW ticket machine is being experimented with on the L.G.O. route 16, Victoria and Cricklewood, and on the Kingston and Twickenham route of the London United Tramways. This machine prints the class and price of the ticket, the stage point from which the fare is paid, and serial number of the ticket, the trip number of the tramcar, the code letter representing the day of issue, and, finally, the total number of tickets sold and the amount of cash received.

AN important conference on the question of world air routes took place at the Air Ministry on Wednesday last, August 7th, when Lord Thomson, the Secretary of State for Air, met Monsieur Laurent-Eynac, the French Air Minister, and in company with the respective directors of Civil Aviation for the two countries, discussed questions relating to commercial aviation. From an official report of the conference we gather that the discussion resulted in agreement, both in principle and in certain details for the development of air transport in Africa, the Middle East, and the Far East, and also South America. The schemes discussed are based on wide mutual co-operation between the two countries, and should be productive of results which will add to the frequency of the present air transport services and the opening up of new routes.

IT seems probable, says the Board of Trade Inspector who was deputed to investigate the explosion of a water-tube boiler in Winsford, that the overheating of the tube which failed was the result of scale deposit and retardation in the circulation. As the "run"—of the process for which the boilers supplied steam—approaches completion, the boilers nearest the outlet end of the steam main will become capable of supplying the reduced demand for steam, with the result that No. 1 boiler—the most distant—will frequently be in a state analogous to "banked fire," under which condition the circulation in the boiler will be feeble or stopped, and as steam is generated in the tubes it will adhere to the surfaces which are roughened by corrosion, even if free from scale, consequently the tubes will tend to become overheated. Although found to be practically free from scale after the explosion, it is probable that the circulation in the tube which burst was seriously retarded by a flake of scale becoming detached and sinking in the tube till it lodged in the lower bend. It appears that, in addition to being kept clear of scale, the interior surfaces of the tubes, particularly in the fire nest, must be maintained smooth.

THE RECLAMATION OF THE ZUYDER ZEE

(*For description see page* 136)

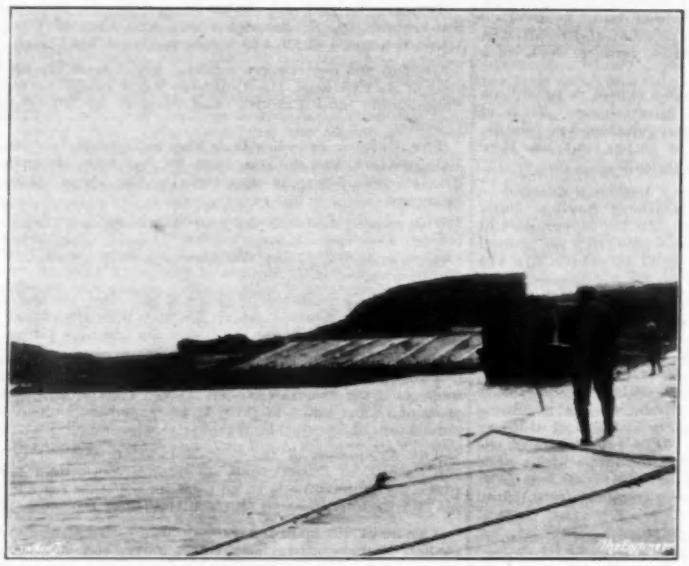

FIG. 8—MATTRESS LAUNCHED AND READY TO BE TOWED TO POSITION

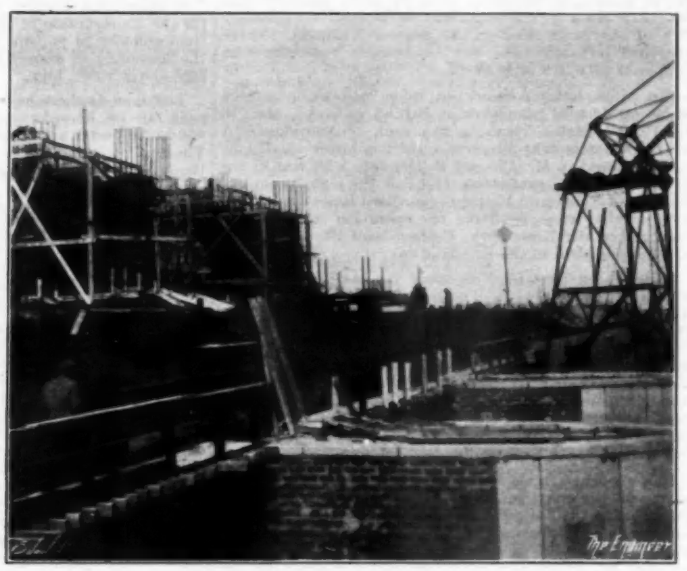

FIG. 9—INNER END OF SLUICES AT DEN OEVER

FIG. 10—DYKE FOR NORTH-WEST POLDER

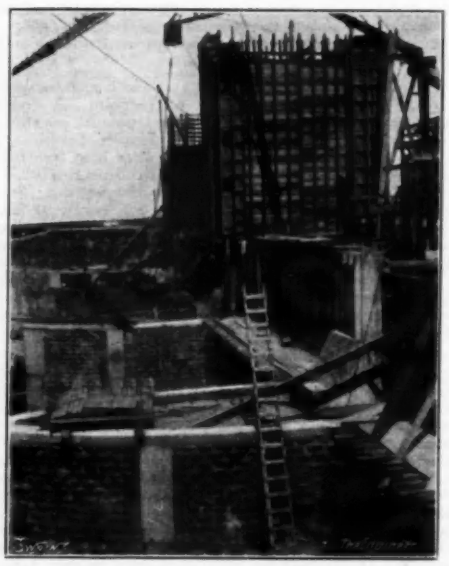

FIG. 11—CONCRETE TOWERS FOR SLUICE GATES

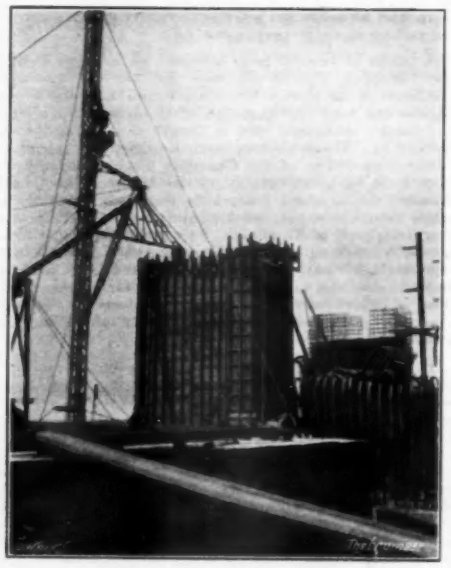

FIG. 12—SLUICE TOWERS AND POURING MAST

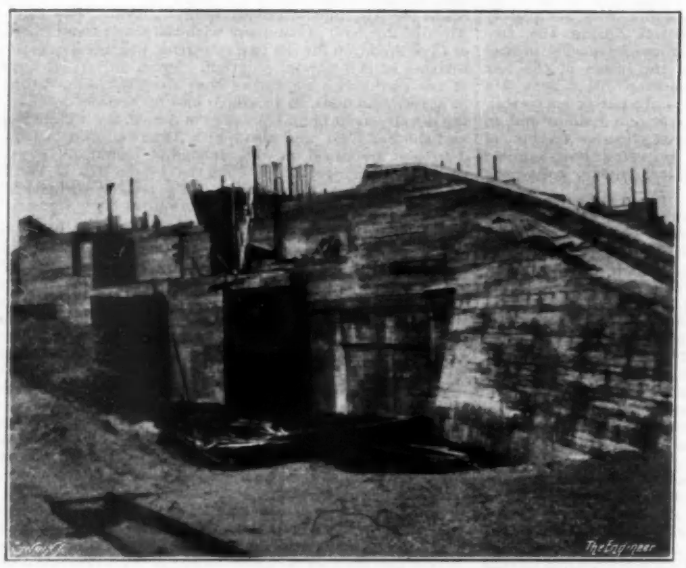

FIG. 13—END WALL OF ONE SET OF SLUICES

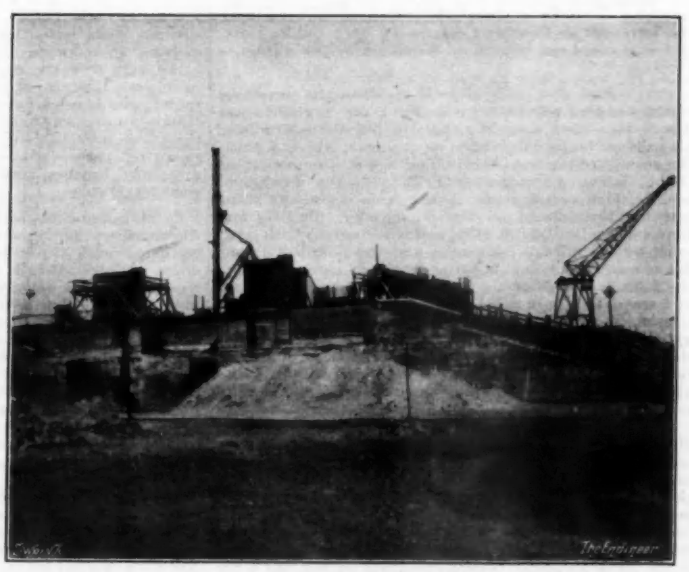

FIG. 14—A SET OF SLUICES

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THE ENGINEER.

AUGUST 9, 1929.

Naval Disarmament.

BY suspending the construction of two heavy cruisers, besides cancelling outright the depôt ship "Maidstone" and two submarines, the British Government has given what should have been accepted as convincing evidence of its wish to promote naval reduction. Unfortunately, the full significance of its action does not appear to be appreciated in certain quarters abroad. Mr. Fred Britten, speaking for the Big Navy party in the United States, declares himself unimpressed by this "scrapping of paper ships;" some of the leading American newspapers are equally sceptical; and Senator Borah, a consistent advocate of naval limitation, invites us to sink ships already afloat in order to scale down our cruiser tonnage to parity with that of the United States. These critics, well-meaning and otherwise, are obviously unacquainted with the actual facts. What the Government has done is to reduce by 50 per cent. the naval programme, not of this year but of last year, which Parliament had passed and for which large funds had been voted. The "paper ships" referred to by Mr. Britten are the 10,000-ton cruisers "Surrey" and "Northumberland," the large depôt ship "Maidstone," and two submarines of at least 1500 tons each. Work in connection with the building of these units was actively proceeding, orders for material to the value of £1,750,000 had been placed, and a further £1,400,000 had been set aside for continuing the work in the current year. Contracts for the machinery, armament, and equipment of all five vessels were in process of execution. In stopping their construction the Government must have fully realised that its action would involve a serious dislocation of the work of the shipbuilding and armament firms, apart from its effect on the Royal Dockyards. Firms whose contracts have been cancelled will, of course, expect compensation, and, unless there are to be wholesale discharges from the dockyards, it will be necessary to find alternative, and probably unprofitable, work for those establishments. Altogether, therefore, this latest cut in the naval programme is going to cost the country a pretty penny. It represents, indeed, a very real sacrifice, and will, we are confident, be recognised as such by all foreign observers who are not blinded by ignorance or prejudice.

While we naturally regret this new and severe blow to industry, we are not disposed to criticise the Government for the action it has taken. Already it has evoked in America a response both prompt and generous. Immediately after learning of the Prime Minister's decision, President Hoover gave orders for the suspension of three 10,000-ton cruisers which were to have been started in a month or so. It was no light thing to do, for he has been bitterly assailed by the powerful interests behind the Big Navy movement in Congress and in the Press, which fear, apparently with good reason, that their cherished fifteen-cruiser programme is in danger. Believing, as we always have, that amicable relations with the United States should be a cardinal aim of our foreign policy, and knowing, as we do, that the controversy on relative naval strength is almost the only obstacle that hinders such relations, we think the circumstances fully justified the sacrifice of certain new ships. It has long been manifest that the shrinkage of international naval strength which has become a political necessity cannot be effected by words alone. Sooner or later it was bound to come to a question of scrapping actual ships, and someone had to take the initiative. This our Government has now done, after duly weighing the economic consequences. In spite of adverse comment in a certain section of the American Press, responsible opinion in the United States has received our gesture in the spirit which prompted it. That is made clear by the President's action with regard to the new American cruisers. Conversations are meanwhile proceeding between the Prime Minister and the American Ambassador. Their purport may be readily imagined. Both sides are anxious to reach a definitive solution of the naval problem as speedily as possible, but both are alive to the vital importance of finding common ground before entering into formal conference. Lack of preparation caused the failure of the Three-Power meeting at Geneva in 1927. There must be no repetition of that calamitous mistake. The Prime Minister, in his statement to the House of Commons on July 24th, said that agreement had been reached on the fundamental issue of parity. That remark, we fear, is likely to foster the erroneous impression that Great Britain had, until quite recently, declined to concede the principle of equality. At no time since the Washington Conference has there been any serious question of refusing parity to the United States. To have done so would have been not only impolitic but futile. The point at issue was not whether we should accept naval equality, but whether the common standard of strength should be fixed to suit the defensive requirements of the British Empire or the incomparably more limited needs of the United States. It now seems to be accepted in London as well as in Washington that some arbitrary standard—bearing no logical relation to strategic necessities—will have to be agreed upon if a settlement is to be reached.

We adhere to the view, which we have often expressed before, that, in reducing naval power to such an artificial standard, this country will be incurring risks immeasurably beyond those to which the United States may be exposed. In the naval sense, the latter is as impregnable as we are vulnerable. It is to be hoped that our Government will never for an instant forget this all-important fact, and that, while making every rational concession in the impending negotiations, it will insist on the British Empire retaining such measure of battleship, cruiser, and ancillary tonnage as would enable us, according to the calculations of our senior naval officers, to afford adequate protection to our far-flung trade routes under all conceivable conditions. That is the main consideration. But there are others which, though they cannot be expected to influence decisions in the realm of high policy, are nevertheless of crucial importance to large sections of the community. It the present unsatisfactory state of the shipbuilding, engineering and allied trades, any further reduction in the modest yearly average of naval construction which has obtained since the war will be a serious matter. Although Admiralty contracts are not particularly lucrative to the firms that book them, they do provide work for thousands of wage-earners. Hundreds of men have already been affected at Dalmuir by the cancelling of a submarine which Beardmores were to have built. There is, we are relieved to learn, no truth in the report that H.M.S. "Exeter," the "B" class cruiser completing at Devonport, is to be scrapped. On the other hand, the suspension of the cruisers

"Northumberland" and "Surrey," which were to have been laid down forthwith at Devonport and Portsmouth respectively, signifies a black winter for those ports, though the gloom has been somewhat brightened by last week's news that four battleships are to be transferred in November from the Mediterranean to the Atlantic Fleet, a change that will bring additional work to the Royal yards. At Chatham, however, where the large submarine depôt ship now cancelled was to have been built, the situation is very serious. It is difficult to see how alternative work of a suitable nature can be provided for this yard, which has been carrying on under peculiar difficulties ever since the peace. All over the country, in fact, the impending retrenchment of naval armaments will involve much personal hardship, and not least to those officers and men of the Royal Navy who will become redundant. Highly trained in and for their profession, they are not too well equipped to compete in the labour market ashore. It is, however, ordained that the few shall suffer for the good of the many, and if international naval reduction has the stabilising effect on world peace which we are invited to believe, its individual victims are not likely to complain. Finally, we would direct attention to a most important circumstance which appears to be escaping general notice. In July, 1925, Parliament approved a five-year shipbuilding programme drafted to cover building requirements up to and including the financial year 1929. It provided for 16 cruisers, one aircraft-carrier, 27 destroyers, 24 submarines, and two submarine depôt ships. This was described at the time as the irreducible minimum needed to insure protection by sea in the years to come. What has been the fate of this "irreducible" programme, now in its final year? So far there have been started eight cruisers, 18 destroyers, 16 submarines, and one submarine depôt ship. Eight cruisers have been cancelled, suspended, or shelved, together with the aircraft carrier, the second depôt ship, and two submarines, and in view of the negotiations with foreign Powers the fate of the remaining craft is, to say the least, problematic. It will be seen, therefore, that we have cut down our quinquennial programme by nearly one-half. We commend this fact to domestic and foreign critics who still profess to be dissatisfied with Great Britain's contribution to the cause of international naval disarmament.

Boredom.

"Lives there a man with soul so dead"—that he has never been bored? We have, we admit, heard people assert that they found so much to interest them in everything and everybody that they never suffered that agony. But as they themselves were unutterable bores, they were, if not bored themselves, the origin of boredom in others, and so increased the adverse balance. Yet common as the complaint is, how many of us could define it with accuracy? How many could develop "the inhibitory theory of boredom from a consideration of simple muscular activities," or derive the simple, obvious fact that it is associated "with the repression of distracting stimuli arising from the activity of unfatigued mechanisms and natural impulses"? Few of us were we asked to say what "boredom" was could go beyond the dictionary definition that "it is the state of being bored." Yet we know the sensation. We may be bored, like Hawthorne, by a poet reading his own verses; we may be bored at Lord's by the "stonewaller"; we may be bored by the man who tells us over and over again about his children, about his golf, or about his fishing; or we may be bored by our work or our leisure. The effects in all cases are the same. A sense of indefinite irritation amounting to malaise, a desire to be rude to somebody, a psychical ennui amounting to definite fatigue. "He bores me to extinction" is not merely an unsubstantial phrase. It means what it says. All the senses are confused; the mind loses its activities and becomes a dull and stupid thing; one might as well not exist. The whole nervous system is put into a state of turbulence. One longs to flee; to run amok. In "Gallion's Reach" it was the boring monotony of old Perriam's conventional "jawing," superimposed on monotony of occupation, that led Jimmy Colet to strike suddenly the unpremeditated but fatal blow. Boredom is a malign power; at the worst it may lead to murder; at the best it reduces the ability of 73·5 per cent. of us by 5 per cent!

We take these scientifically precise definitions and figures from a report on "The Effects of Monotony in Work," recently issued by the Industrial Research Board. A scientific investigation of so intimate and personal a thing as the feeling of boredom is too much for us, and we have failed in the attempt to read it all. But there are "Introspective Remarks Obtained from the Subjects" that have the human touch, the real, unscientific feeling for boredom. They, at least, ring true. "I am sometimes bored to tears," said a young lady who had to weigh tobacco all day. "I don't like the machinery; it gets on my nerves"—real boredom—said another who lives by wrapping up soap; "I feel like walking about"—have we not all experienced that feeling at "parties"?—exclaimed a third, who earns a precarious livelihood by winding; and, finally, there was one who admitted that she said to herself, "Isn't this a rotten job!" The observers tried to estimate the effect of this boredom, born of monotonous occupation, upon the output of the subjects. They tell us that there is a period of diminution in the middle of the spell usually lasting from one to two hours, during which the rate of output falls by between five and ten per cent. All save 26·5 per cent. of the "subjects" admitted that they were bored part of the time. Were they not really bored *all* the time, and did not know it? Were they not bored in the morning over their breakfast, when they knew they had to go back to their monotonous task, and again at dinner when they knew that more weary hours had to be spent winding, wrapping soap, or weighing tobacco? Their working lives are all boredom, and it is only when in the afternoon they look forward to going home, as they "play tennis in summer and dance almost every night in winter," that they forget how bored they are. The more intelligent they are, the more they suffer; the more stupid and machine-like, the less they feel the monotony. Yet the more intelligent are "usually above the average in productive efficiency." But the work that requires no intelligence, hardly any attention at all, is no more boring than that which calls for constant concentration. In the former case the "subjects" can think of something else—or of nothing. Semi-automatic work is the most boring. It demands "enough attention to prevent mind-wandering, but not enough for the complete absorption of mental activity."

"No self-respecting unhypocritical engineer likes to get caught in a humanitarian action if he can conceal it in economic camouflage," said a witty American. Lest we should forfeit both qualifications, we shall only consider the reduction in output amounting to between five and ten per cent. during the boredom period. It does not come to much in the whole day, perhaps to a reduction in the possible total output from the sufferers of two or three per cent. Yet it would be worth removing. The easiest course is to make the boring operations still more automatic—just so automatic that they demand the use of the hands without the brains—like walking or breathing. Another way is to give constant change of occupation. It would be interesting to know if that has ever been tried. A "General Post" once in the middle of the morning and again in the afternoon should be practicable in many factories, and if it increased the output by one or two per cent. would justify itself. Another plan is so to arrange the "subjects"—generally girls—that they can chatter to their heart's content, and yet another which we believe is in actual use in suitable factories is the provision of a band or at least wireless or the gramophone. In the now extinct "sewing-bees," one lady used to read aloud whilst the others plied their needles. That also suggests a line of attack. It is an interesting fact that whilst many phenomena may be quite familiar to all of us, very few think of using them, if they are useful, or displacing them if they are noxious, until they have had a blue-book or a scientific report upon them. Boredom in the factory has been known ever since factories were started, but only now that we are assured by scientific observers that it reduces output—of which every manager was fully aware—are we likely to see any serious attempt to reduce it.

Newcomen Society.

SUMMER MEETING.

As mentioned in our issue of July 26th, the bicentenary of the death of Thomas Newcomen, the father of the reciprocating steam engine, was commemorated at Dartmouth, his birthplace, on July 23rd–26th by a joint meeting of the Devonshire Association for the Advancement of Science, Literature and Art and the Newcomen Society for the Study of the History of Engineering and Technology.

The first morning was devoted to the transaction of business. In the afternoon, in the absence through indisposition of the Mayor of Dartmouth, Alderman H. J. Campbell, M.D., the Deputy Mayor, Alderman W. T. Pillar, received the company and entertained them to tea on behalf of the borough of Dartmouth. Later he headed a procession to the Newcomen Memorial in the Town Gardens, where a eulogy on the inventor was pronounced by Mr. L. St. L. Pendred, President of the Newcomen Society.

Mr. Pendred remarked that we must put our minds back a couple of centuries if we were to appraise fully the marvel of Newcomen's intelligence. The mines of Devon and Cornwall, among which he lived and worked, were being killed by the influx of water with which the antique pumping plant of the day was unable to cope. That was the difficulty that inspired him. He had brooded on the subject, perhaps experimented, maybe for twenty years. His glory was that he alone produced an engine so perfect in its simplicity that for six decades no radical improvement in it was effected. The marvel was that he should have tried at all. We must suspect that he had:

> "The divine insanity of noble minds,
> That never falters nor abates,
> But labours and endures and waits,
> Till all that it foresees it finds,
> Or what it cannot find creates!"

The man who has the courage to perform is the true pioneer, and such a man was Thomas Newcomen, ironmonger, of Dartmouth. Let us revere his memory.

In the evening, at the Subscription Rooms, Dr. George P. Bidder, President of the Devonshire Association, delivered his presidential address on "The Sea." One learnt that the idea of the ancients that we live, move, and have our being from the ocean is based on solid fact. We hope to refer to this address again at greater length.

On Wednesday, July 24th, the Newcomen members left their *confrères* to the discussion of papers while they went on a motor tour under the guidance of Mr. T. J. Joce to the oligocene beds of Bovey Heathfield, visiting on the way thither at Holbeam the interesting edge tool forge actuated by water power of Mr. F. G. Loder, by his kind invitation. For centuries a trade in shovels locally and in edge tools with Newfoundland has been done here.

The Bovey beds—vast deposits of pottery clay from disintegrated granite and lignite on the bed of a former lake—attracted much attention. The lignite is of the same formation that is so much used in Germany in power stations, and was at one time used to supply steam for pumping purposes, but its calorific value, except in certain places, is too low for economical use.

Hay Tor was next visited for the purpose of inspecting the granite tramway along which the stone for London Bridge was brought a century ago, from an elevation of 1200ft. to the level of the Stover Canal, dug for the purpose, and taken thence for shipment *vid* Totnes. Much of the tramway is still *in situ*, including a turn-out which was specially noted.

The party motored back to Dartmouth—not without losing one of the members, an incident that seems now an invariable concomitance of these meetings—in time to join the Devonshire Association in a trip by water to Dittisham Church and to Greenway House, the birthplace of Sir Humphry Gilbert, the Elizabethan navigator. The beautiful gardens and sylvan grounds were thrown open by the kindness of the present owners, Comm. Chas. Williams, R.N.V.R., and Mrs. Williams. In the evening both societies were entertained in the Subscription Rooms by Jan Stewer, the well-known Devonshire dialect reciter.

On Thursday, July 25th, a visit by motor to see Brunel's famous bridge at Saltash was undertaken. The party was received at Plymouth-road Station by Mr. H. S. B. Whitley, Divisional Engineer of the Great Western Railway, who conducted the members in his inspection coach and a saloon to Saltash Station. On the way thither he gave a history of the bridge and of the recent approach girder replacements, illustrated by a number of drawings and photographs—no small undertaking, since, being single line, the supporting girder had to take both the old and new spans and the work had to be done in the limited hours available on Sundays.* A few of the more experienced of the party were allowed to walk across the bridge, which affords but little room when trains are passing, as they did to the number of half-a-dozen while the party was there. Mr. Whitley joined the party at luncheon at Plymouth, and a pleasant drive back through Devon lanes followed. In passing through Modbury in the morning, the home of Thomas Savery, the inventor, was seen. Dartmouth was reached *vid* Torcross and Slapton sands, truly a day of "hills and the sea."

In the evening Eng.-Capt. E. C. Smith, R.N., afforded a great treat to the members and to the local public by an address, illustrated by lantern slides, on "Thomas Newcomen: Two Hundred Years of Steam Power." He gave a brilliant account, listened to with close attention, of the invention of Newcomen, of its development at the hands of Watt, of Trevithick's high-pressure engine and the consequent birth of the locomotive, of the first steps in steam navigation, and of the coming of the steam turbine.

* This work was illustrated and described in our issue of June 21st, 1929.—Ed. The E.

Friday, July 26th, was devoted to a joint excursion of both societies. After a delightful trip on the river Dart to Totnes, motor coaches were taken to Ashburton and near Holne Bridge, the site of an undoubted blast-furnace, which is known from documentary evidence to have been at work in 1609, was pointed out by Mr. R. G. Hansford Worth. A large heap of slag and the hearth of the furnace alone remain to tell of a remarkable enterprise for Devon, undertaken probably to meet local requirements. The route then taken mounted past Venford Reservoir on to Dartmoor, where the views of the tors in the brilliant sunshine were superb. After luncheon a visit was paid to a tin "blowing house," *temp.* Elizabeth, at Gobbet in the Swincombe Valley. This again was explained by Mr. Worth. The "stream" or washed tinstone was reduced to the metallic state in a hearth furnace, blown by bellows, by means of charcoal or possibly peat, for Mr. Worth was able to substantiate by documentary evidence (5 Edward IV., Patent Rolls) that peat charcoal was made on Dartmoor in 1465, and that still earlier, in 1201, peat was used in tin smelting. The granite moulds for casting the tin, the granite boulders in which the slag was pounded to extract pellets of tin, the "crazing" stones, after the pattern of a grist mill, subsequently used more efficiently for the same purpose, were closely inspected as they lay there on the turf. A short drive brought the party to the romantic Badger's Holt, Dartmeet, where a "Devonshire tea" was served. The return trip and the sail on the Dart in the reverse direction were most enjoyable. The weather throughout the meeting was delightfully fine.

Literature.

Blast-furnace Practice: Vol. II., Design of Plant and Equipment. By FRED CLEMENTS. London: Ernest Benn, Ltd. Price £3 3s.

THE first volume of Mr. Clements' book dealt with general principles and with the source, preparation, and handling of the raw materials employed in the blast-furnace, subjects, that is, of common ground and respecting which there can hardly be much divergence of opinion. In the present volume, which is devoted to the discussion of the design of plant and equipment, new ground is broken and some, at least, of the matters dealt with may be considered to be of a controversial nature. In the circumstances it might have been anticipated that Mr. Clements would have displayed some degree, if not of bias, at any rate of distinct predilection for his own methods and practice. Careful perusal of the new volume fails, however, to reveal anything of the kind. With regard to any sections dealing with matters respecting which the views of experts differ, the author has held an unprejudiced balance and has confined himself to stating the case for both sides with commendable detail, and in no way attempting to force his own views on his readers.

Those who remember the lively discussion which arose on the occasion of the reading of a paper "Notes on Blast-furnace Filling" before the Iron and Steel Institute in 1922, as to the relative merits of bucket *versus* skip filling—subjects discussed exhaustively in the present volume—will turn to the two chapters entitled respectively "Distribution of Solid Materials" and "Skip and Bucket Charging and Hoisting Gear," and in the former will find the comparative advantages and disadvantages of both set out with the utmost fairness, while in the latter innumerable detailed examples of each method of charging serve to show that even an expert can display impartiality. In this, as in many other details of blast-furnace practice, so many considerations govern the case that no hard-and-fast line can be taken, and the author has shown a wise discrimination in not attempting to do so. At the same time, with the wealth of detail placed at his disposal, a reader should hardly be in doubt as to which, given his own circumstances, it would be best to adopt, when faced with the problem of designing and laying down a new plant, or as to the extent to which an existing plant could reasonably be modified in favour of either.

To convey an idea of the scope of the new volume it is needful briefly to enumerate the chapters into which it is divided. The first three deal with the choice of site, capacity of units and general commercial operation of the plant; with the general layout; and with the design of stack, bosh, and hearth. Then come the two to which reference has been made above, and a chapter on refractory materials for linings. The crude gas system; the provision and distribution of the air blast, and the design and operation of the hot blast stoves constitute the subjects of the next three chapters, after which the handling of the iron and slag, and auxiliary machinery and indicating gear are dealt with. The last of the thirteen chapters into which Vol. II. is divided deals with the pyrometers and other instruments, such as pressure and flow meters, CO_2 recorders, &c., which, in a modern and scientifically conducted plant, are essential to the securing of adequate control over the operations, and especially of the economic factors, such as fuel consumption, proper use of the waste heat, &c., upon which the financial success of a plant so greatly depends.

It will be seen from the foregoing that Mr. Clements has not as yet reached that part of his work which is to be devoted to "Operation" or blast-furnace practice proper, viewed from the standpoint of the actual handling of the furnace itself, during the process of smelting. This and the subject of the utilisation of the subsidiary products of the blast-furnace process are reserved for the final volume. The plan of the work, as a whole, is thus revealed, and may be said to be admirable, well balanced, and as logical in arrangement as it is exhaustive in detail. As in the earlier volume, the author has laid under contribution a vast mass of comparative data, drawn from the blast-furnace practice of our own country and from that of practically every other country in which pig iron is produced by the blast-furnace process. From these data the practice most suited to any given set of circumstances can be safely derived, and thus the author has rendered an inestimable service to the whole industry throughout the world.

Mr. Clements lays great stress, and rightly so, on the need for sizing and grading the materials charged, not only with regard to their dimensions, but with respect to their chemical analysis as well, since, as he says, the distribution in the furnace must have due regard to the quality of the charge as well as to the actual size of the pieces. Uniformity of size, chemical composition, and physical condition—density, hardness, moisture, &c.—not in the ores alone, but in the fuel and fluxes as well, and, as far as possible, in the composition of the air blast, are essential factors to regular and economic working, to fuel economy, to uniformity of product, ease of handling, and the life of the furnace itself. Hitherto such uniformity of materials has been an ideal condition to which it has been hardly possible to give other than lip service, as circumstances of space, storage capacity and handling have been against anything more than a rough and tentative approximation to the ideal. It is not too much to hope that, with "rationalisation" in the air and vast schemes of merger and combination, a nearer approximation should before long be possible, by the pooling of space resources and of handling and transport appliances, so that a furnace or a group of furnaces should be able to draw their raw material supplies in a condition of far greater uniformity than, with a number of small and isolated plants, it has hitherto been possible to operate. Readers of Mr. Clements' book will find, in his pages, the necessary justification for such a policy, which is one that on the score of economy and efficiency, is greatly to be desired. In conclusion, it may be said that Vol. II. of "Blast-furnace Practice," which has followed with commendable promptitude the issue of Vol. I., is fully equal to its predecessor, and a noteworthy addition to the literature of a subject of the greatest importance to our country and our Dominions.

Two Essays in Early Locomotive History. By C. F. DENDY MARSHALL. London: The Locomotive Publishing Company, Ltd. 1928. Price 12s. 6d. net.

WE are fast approaching the centenary of the most important milestone in the history of railways—the Rainhill trials of 1829—and for that reason the first of these two essays is of exceptional interest. A few years ago the late Mr. E. L. Ahrons completed in these columns the fullest account that has ever been written of the steam locomotive at and after the opening of the Stockton and Darlington Railway in 1825. Mr. Dendy Marshall has carried the history backwards to the very beginnings of railway locomotives. A review of the kind was wanted. Around the earlier engines and their builders stories without foundation had accumulated, and it required someone with a severely critical eye and an intimate knowledge of the facts to lop off the erroneous material and leave us with that, and nothing more, which could be substantiated by trustworthy evidence.

He begins, as every historian of the locomotive ought to begin, with Trevithick, the true and first inventor of the locomotive engine. If some mystery still enshrouds "Capt. Dick's" London locomotive "Catch-me-who-Can," there is none about the Pen-y-darren engine of 1804, which may justly be regarded as the first railway locomotive. Compared to the familiar sketch of "Catch-me-who-Can," it is a clumsy affair, but it worked. Trevithick's is followed by Blenkinsop's engines, built by Matthew Murray, of Leeds, in 1812–13. Trevithick had demonstrated by actual operation what Hedley proved later by experiment, that frictional adhesion between wheel and rail was sufficient, yet Blenkinsop used a rack, and, though it was due to ignorance, he must be regarded as the originator of rack railways. In 1813 Hedley produced "Puffing Billy" and "Wylam Dilly," engines more famous than George Stephenson's first locomotive, "Blucher," of 1814, and only a little less illustrious than "Locomotion" or "Rocket." Stephenson made ten engines between 1814 and 1825, when the celebrated firm was established, and the history as given by Mr. Ahrons begins. Here Mr. Dendy Marshall overlaps his predecessor, for his first essay is entitled "The first Hundred Railway Engines," and, of course, includes the engines of Hackworth, Ericsson, Foster and Rastrick, Bury and others. He takes each of the famous locomotive engineers in turn, and gives a very brief summary of the principal and ascertained facts about their engines. He does not go into much technical detail, being interested rather in what one may call the collector's point of view.

In the second and shorter essay Mr. Marshall summarises, in much the same way, the history of British locomotives in the United States and Canada.

Useful features of the volume are:—(1) A table of the first hundred locomotives; (2) an index of Designers and Constructors; and (3) indexes of Engines and Railways. As a trustworthy work of reference, these two essays may be safely recommended to antiquarians of the locomotive.

Power Transmission Pole Setting.

THE following account of the re-installation of an electric power transmission line, which had been wrecked in Canada, is taken from the *Bulletin* of the Hydro-Electric Commission of Ontario, and shows how explosives may help in such operations.

The rising waters in the Great Lakes have encroached on Wasaga Beach, one of the most popular summer resorts on Georgian Bay, to such an extent that the famous motor speedway along the beach has practically disappeared.

This summer resort has had the advantage of electric service since the summer of 1923, being served by a line from the end of the Stayner distribution system where the voltage is transformed from 4000 to 8000 volts.

When the construction of lines along the water front was undertaken an effort was made to secure information as to the high-water marks along the shore, and the pole line was arranged well up on a sand ridge a considerable distance from high water. On account of the combination of high water and strong winds during the spring, the shore line gradually receded, with the result that the pole line was dangerously close to the water's edge.

On May 16th a very high wind from the north-west arose, and reports were received that a number of the poles were leaning badly. An effort was made to support these poles temporarily, and while a number of poles were saved from falling, it was impossible to protect the entire line. When the storm subsided some fifty poles were down and a great number undermined.

The adjacent fence posts had been exposed to view for the first time in many years. Inquiries among the older residents of the district disclosed the fact that this fence was originally part of an enclosure used for pasture lands.

A careful study of the situation was made, and it was decided to reset the poles which were down or undermined in their original positions, observations having indicated that future storms would tend to build up the beach rather than to wash away additional sand.

A construction crew was rushed to the scene, but on account of the proximity of the water it was found impossible to dig to a depth of more than 12in. to 18in. before trouble was experienced with sand and water flowing into the hole as rapidly as it was excavated.

Wooden barrels and standard steel digging shields were employed, but did not overcome the difficulties encountered, as the barrels collapsed under the pressure, and it was almost impossible to remove the steel shields once the hole was dug to the required depth. Four sets of blocks were used, and it was finally necessary to fasten the rope from one set of blocks to the truck before the shield could be removed.

The net result of the first day's operation was three poles erected, and as the task involved the resetting of approximately 4 miles of line, it was readily seen that other methods would have to be devised.

Some months previously the technical Press had (says the *Bulletin*), a brief reference to the effect that poles were being set through swamp lands in Florida by means of dynamite, but no details as to the procedure followed were given. As it was essential, however, that service should be resumed as speedily as possible, it was decided to initiate some experiments with dynamite.

Six sticks of 60 per cent. stumping powder were secured, and preliminary experiments were carried out, which proved that poles could be successfully set by this means.

The procedure which was finally adopted was to dig a hole approximately 12in. deep, and then to force a 7ft. length of 1¼in. pipe in the wet sand to a depth of 6in. or 7in.

The pipe was then filled with water, and by means of a ¾in. pipe the sand and water was pumped out. As the sand and water was pumped out, it was found that the 1¼in. pipe could be forced by hand to its full depth of 7ft. One stick of dynamite and three sticks of 60 per cent. stumping powder were then inserted in the 1¼in. pipe, and held in place by means of a wooden rod while the pipe was withdrawn. This left the charge in the wet sand approximately 5ft. below the surface.

The pole which had been roughly pointed at the butt with an axe was then erected directly over the charge, and held in position by means of rope guys attached to the top and running in four directions. When the charge was fired, the pole rose vertically from 6in. to 12in., and then settled in the hole to a depth of approximately 6ft.

It was necessary then to line the pole up with the others immediately, as the wet sand soon flowed back around the pole, making very little back-filling necessary.

The procedure outlined proved most satisfactory, and enabled night service to be resumed on the sixth evening after the storm. When it is taken into consideration that by digging it was impossible to set more than three or four poles per day, this may be considered in the nature of a record.

While most satisfactory results were obtained in re-setting poles which were washed out entirely, difficulties were encountered when an attempt was made to lower poles which had not been entirely undermined, but which were left standing with 2ft. or 3ft. of the pole in the ground.

After making several experiments in re-setting poles which were left standing, it was found that the most satisfactory method was to remove the poles entirely by means of a pole jack and re-set as just described.

In conclusion, it may be pointed out that where flowing sand or quicksand is encountered, poles may be set far faster and most economically by means of dynamite, where due precautions are taken.

The Illingworth Low-temperature Carbonisation System.

In the system of low-temperature carbonisation invented by Dr. Roy Illingworth, a fine coal is used. It is carbonised in vertical chambers, from which it drops, after the process, by its own weight, as a solid mass of semi-coke or smokeless fuel. The plant is characterised by the use of cast iron "conductors," which form the walls of the chambers and conduct the heat from the walls of the retort to the coal. These conductors are arranged in groups so that they form chambers 12ft. or more in height, by 18in. to 20in. in width, and 7in. or 8in. in thickness. The chambers taper slightly towards the top. At the bottom of each, or at the bottom of a group, there is a swinging door held up by suitable mechanism; at the top there is another door and outlets for the distilled gases. The chambers are discharged by opening the bottom doors, no pushers being necessary. They are charged by dropping short pipes into their upper ends. The coal is fed into these pipes by appropriate means. As soon as the coal has reached the lower ends of the feed pipes, the flow, of course, ceases. The coal is then at the required level to leave clearance space for the gases and room for expansion. The small coal used is washed before carbonisation, and is delivered to the plant containing 15 per cent. or more of water. An important detail of the plant is the means taken for drying the raw coal. It takes the form of a large steel drum, mounted on a chassis which can be traversed under the retorts. The drum is provided with large sliding doors, and can be rotated slowly by an electric motor. A charge of damp raw coal is shot into this drum. The chassis is then traversed until the drum comes beneath one chamber of the retort, and the hot semi-coke is allowed to fall in amongst the wet raw coal. The doors are then closed, and the drum is given nine or ten revolutions. The result is that the moisture of the raw coal is driven off by contact with the hot semi-coke, which, on its side, is cooled and broken up. The contents of the drum are then tipped into the hopper of a cutter which breaks the fuel into small lumps. The raw fine coal and the semi-coke are then raised by a conveyor and tipped on to an inclined screen, through which the small coal and breeze passes, whilst the

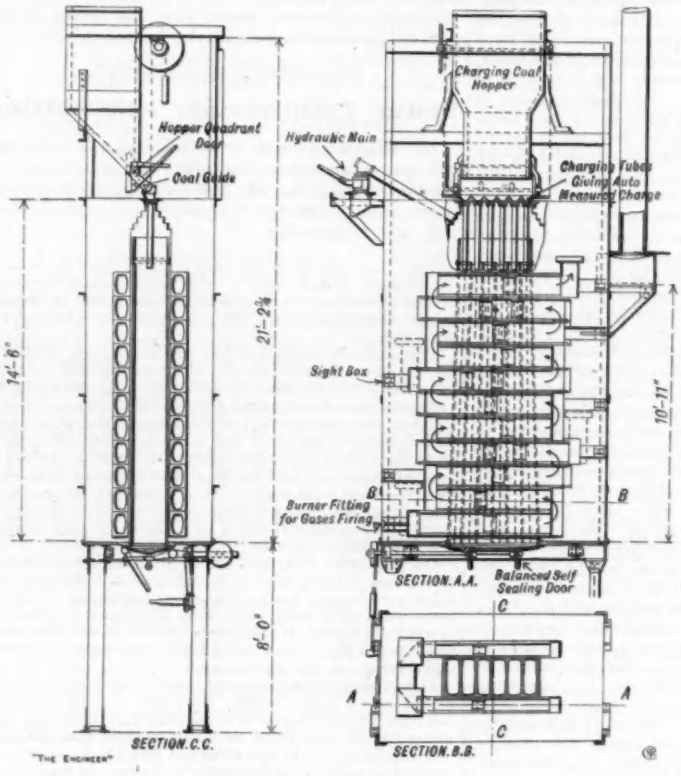


Fig. 1—Demonstration Plant

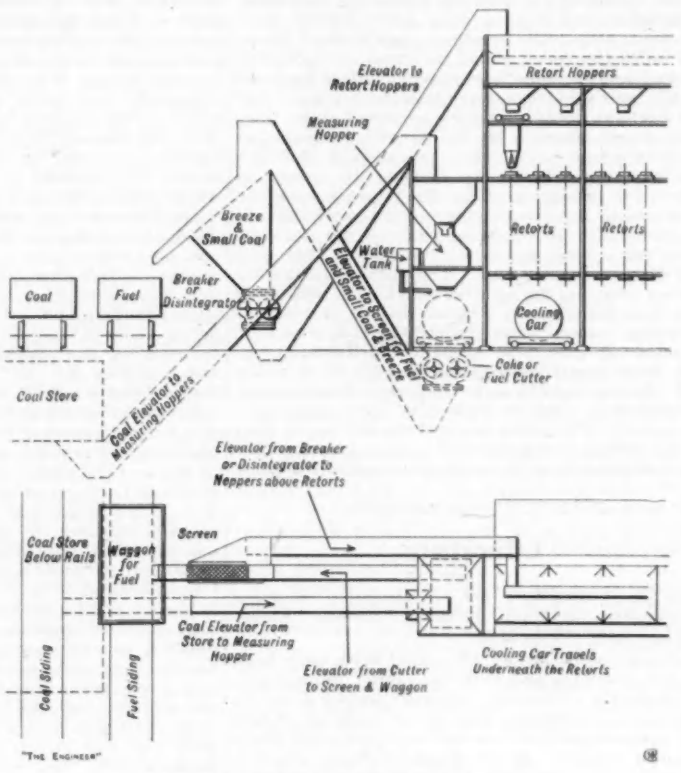
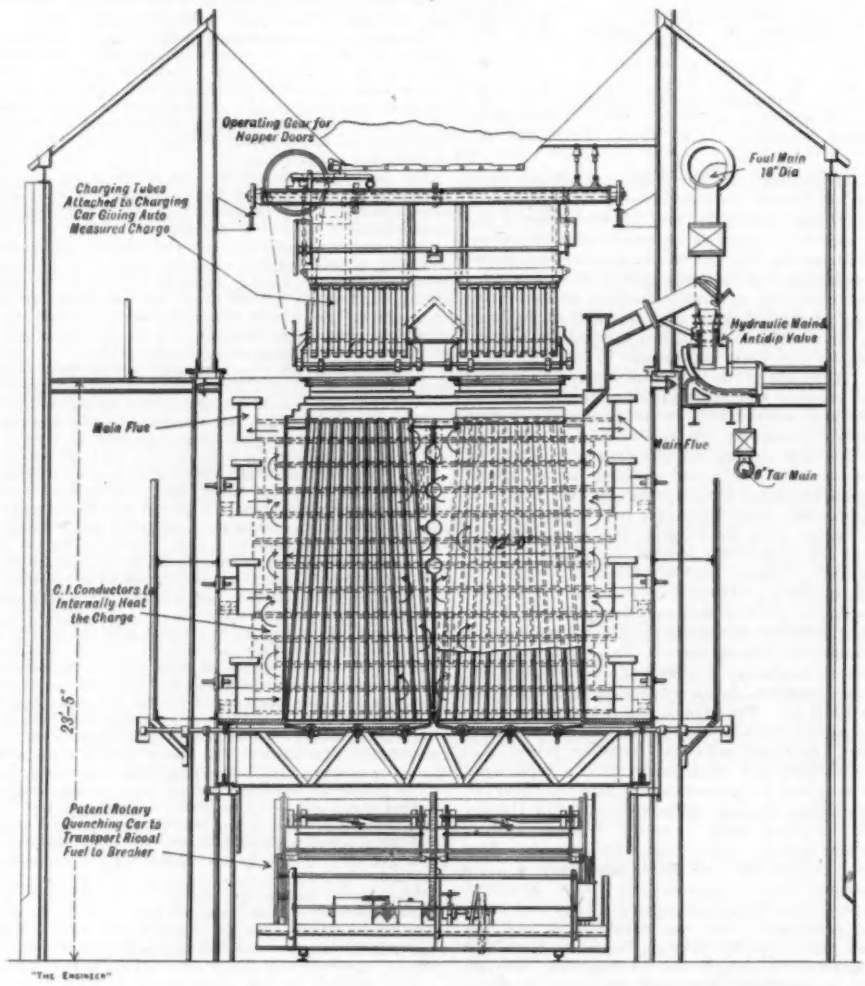


Fig. 2—Diagram of Conveying Plant


Operating Gear for Hopper Doors
Charging Tubes Attached to Charging Car Giving Auto Measured Charge
Fuel Main 18" Dia
Hydraulic Main & Antidip Valve
Main Flue
Main Flue
6" Tar Main
C.I. Conductors to Internally Heat the Charge
Patent Rotary Quenching Car to Transport Hot Coal Fuel to Breaker
23'-5"
"The Engineer"

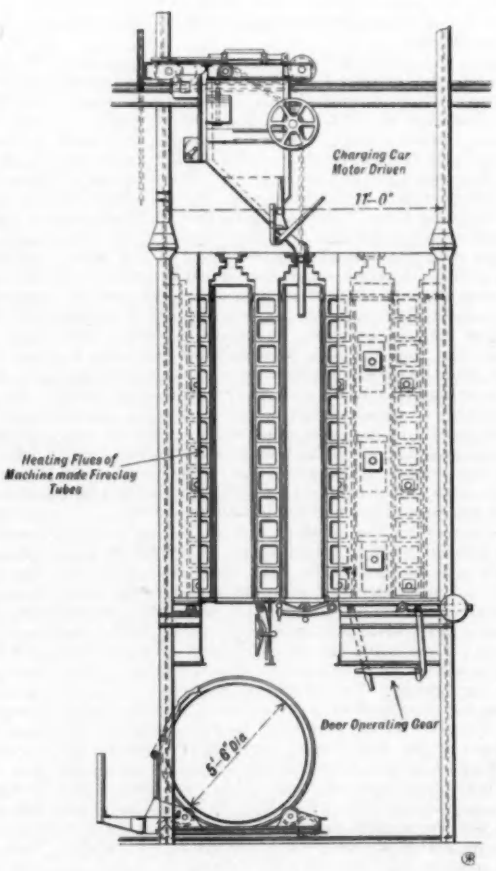


Fig. 3—Typical Plant

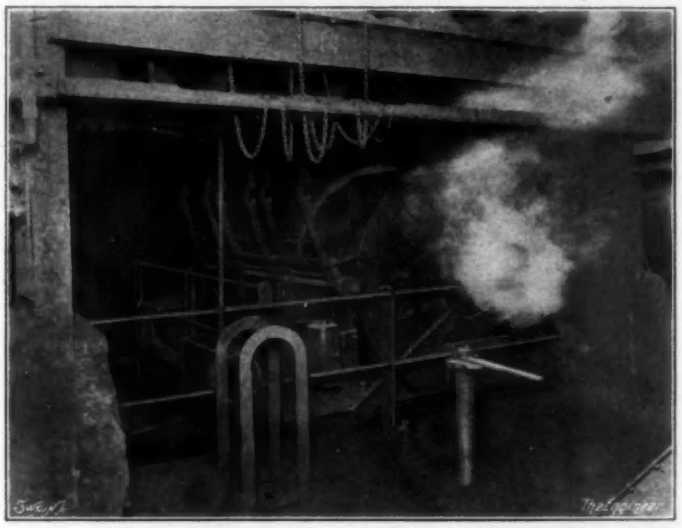
large lumps of fuel are delivered into wagons. The small coal with a small proportion of breeze is then raised by another conveyor to the raw coal hoppers. The employment of small coal has made this neat method of drying possible.

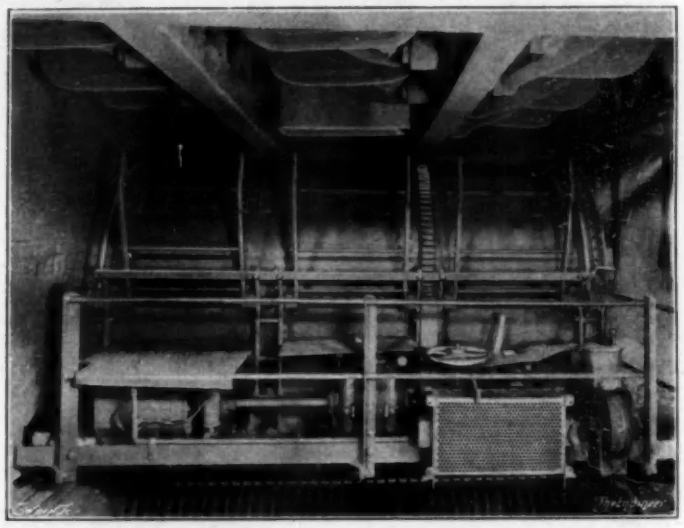
Having now briefly described the principles of the Illingworth system, we may turn to the consideration of the plants which are in operation in the old gasworks at Pontypridd, and which we inspected recently.

The experimental retort is shown by the drawing Fig. 1. It consists of a bank of six chambers formed of cast iron conductors and enclosed within hollow firebrick walls. The hot gases from an external source circulate through the hollow walls as indicated by the arrows, and the heat is carried to the charge of coal by the conductors. The balanced discharge doors with their locks and means of operation are shown below, and the filling hopper and tubes above. The tubes are all fastened to a single cross piece and are raised and lowered by simple mechanism. In this experimental plant the fuel is shot upon the floor. There appears to be no binding in the chambers, the large "ingot" of fuel falling out freely as soon as the doors are dropped. A larger plant is working at Pontypridd on a commercial scale. It also is in the old gasworks, and to avoid initial expense some of the existing structure has been worked in.

The drawing—Fig. 3—on page 150 represents it fairly well, or may be taken as representing a typical plant. The small diagram—Fig. 2—shows the handling and conveying arrangements. The photograph reproduced in Fig. 6 shows the feeder tubes at Pontypridd, hauled up above a triple row of carbonising chambers. The sealing doors have been removed and the tubes are ready for lowering by means of the gear which is seen above them. When they are in position the travelling hopper is brought over the top of them, the swinging doors are opened, and the coal discharges until the flow ceases. In later designs a charging shoot, as seen in Fig. 3, is employed, as it enables the process of filling to be watched.

Figs. 4 and 5 give a good idea of the drying and cooling drum. It is rotated and traversed by an electric motor and appropriate gearing. Particular attention should be given to the doors and their mechanism. The doors consist of curved steel sheets which slide round the drum. They are locked by the latches which can be clearly seen in the engraving. In front of each door there will be seen a pair of pawls, the form of which is well shown in Fig. 4. The hooks on these pawls can be lowered to engage with rods attached to the doors. It is clear that when so engaged they will hold the door at rest, and it is only necessary to rotate the drum in one direction or the other to effect the opening or closing of the apertures. In Fig. 4 a charge has been shot into a drum and steam can be seen issuing from the centre. The drums are perfectly plain inside, no baffles or paddles or similar devices having been found necessary. The speed of rotation is quite leisurely, and eight or ten revolutions has been found sufficient to dry the raw charge.





FIGS. 4 AND 5—THE DRYING AND COOLING DRUM

FIG. 6—FEEDER TUBES

ECONOMICS OF THE PROCESS.

When we turn from the practical aspects of the process to those connected with its economics, we can do no more than repeat figures which Dr. Illingworth put before us as we had, of course, no means of making our own estimates or collecting our own data.

The typical plant, of which the retorts are shown by Fig. 3, may be taken as a basis. This plant is designed for a throughput of 200 tons per day. It is estimated, on the basis of experience, that a complete cycle of discharging and filling a retort, including the filling of the charge larry from an overhead bunker and returning the larry would occupy fifteen minutes. The same period of time is required for discharging a retort from the moment the doors are opened till the fuel is dumped into the elevator boot. Assuming that one man is employed to charge and another to discharge, two men are required for fifteen minutes. Hence, two men on an eight-hour shift will retort twenty-eight charges of 3 tons each, or 84 tons per shift. Three shifts, equal six men, will handle 252 tons per day. The weekly wage per man may be taken as 71s. 3d., so that the total labour cost of retorting per week is £21 7s. 6d., and in seven days 1750 tons of dry coal, or 1925 tons of normal washed slack, can be handled. Hence the cost per ton of retorting is about 3d. on dry and 2¾d. on the wet basis.

The total weekly wages for elevating and screening are put down at £10 13s. 9d. per week, or on the coal basis, 1½d. dry, 1·4d. wet. The siding costs work out at 1d. per ton, and supervision at 1½d. per ton. In sum, fourteen men draw £49 11s. 3d. per week for carbonising 1750 tons of dry coal, or at the rate of 7½d. per ton.

Turning now to maintenance, it is estimated that owing to the simplicity of the equipment ½d. per ton is a sufficient allowance, that management will cost 1·6d. per ton (dry), chemist 2d. per ton, and the clerical staff 1·6d. per ton.

The depreciation on the retorts and coal-handling section is taken at 14½ per cent. of the capital cost, which for a plant of the capacity may be taken as £54,000. On this rate depreciation amounts to 2s. 4d. per ton of dry coal per year of 300 working days.

All these figures, with those for the by-products plant, are summarised in the Table I.

TABLE I.—*Summary of Operating Costs.*

	Dry coal. s. d.	s. d.	Wet coal. s. d.	s. d.
Carbonisation—				
Labour	0 7½		0 7	
Power	0 4		0 4½	
Stores	0 6		0 5½	
Depreciation	2 4		2 2	
Interest on capital	0 8½		0 7½	
	4	5½	4	2½
By-products—				
Labour	0 4½		0 4	
Power	0 3		0 2½	
Stores	0 4		0 4	
Interest on capital	0 2½		0 2½	
Depreciation	0 7		0 6½	
	1	8½	1	7½
Overheads	0	5½	0	4½
Totals	6	7½	6	3

NOTE.—Power has been taken at 1d. per unit. It is, of course, possible to utilise steam power or gas engines operated by the process gas, in which case consideration of it would enter into the power cost stated above.

In the following table a report on tests of Yorkshire coal carburised at Pontypridd is summarised :—

TABLE II.—*Report on Coal Carbonised by the Illingworth Process.*

Analysis of Coal.

	Per cent.
Moisture	9·6
Volatile	35·0
Ash	4·63
Caking index	18·00
Calorific value (dry coal)	15,840
Sulphur	1·03

Screening Test.

	Per cent.
Over ¾in.	1·85
¾in.–½in.	16·5
½in.–¼in.	11·92
¼in.–⅛in.	54·1
⅛in.–1/16in.	7·34
Under 1/16in.	8·25
	99·96

Results of Carbonisation.

	Dry coal. c. q. lb.	Wet coal (10 per cent. water). c. q. lb.
Fuel—		
Over 2in.	13 1 0	12 0 0
Nuts, 2in.–½in.	1 1 0	1 0 14
Breeze under ½in.	0 2 0	0 1 25
Total	15 0 0	13 2 11

Analysis of Fuel.

	Per cent.
Moisture	0·7
Ash	6·6
Volatile	8·6
Calorific value	14,168

	Dry coal.	Wet coal.
Tars, crude, gallons	17·5	16
Liquor, gallons	11	22
Benzol, gallons	4	3·6
Gas, per ton of coal, cub. ft.	5900	5300
Calorific value	680 B.Th.U. per cub. ft.	
Sulphur	0·14 grains per cub. ft.	
Ammonium sulphate, lb. per ton	8	8

Finally, we give in tabular form a balance-sheet prepared by Dr. Illingworth :—

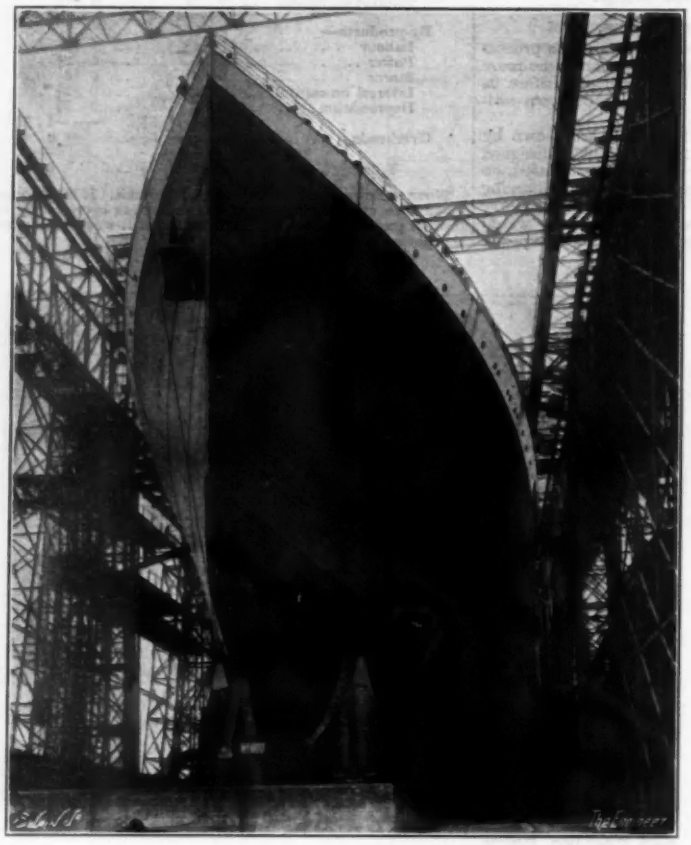
TABLE III.

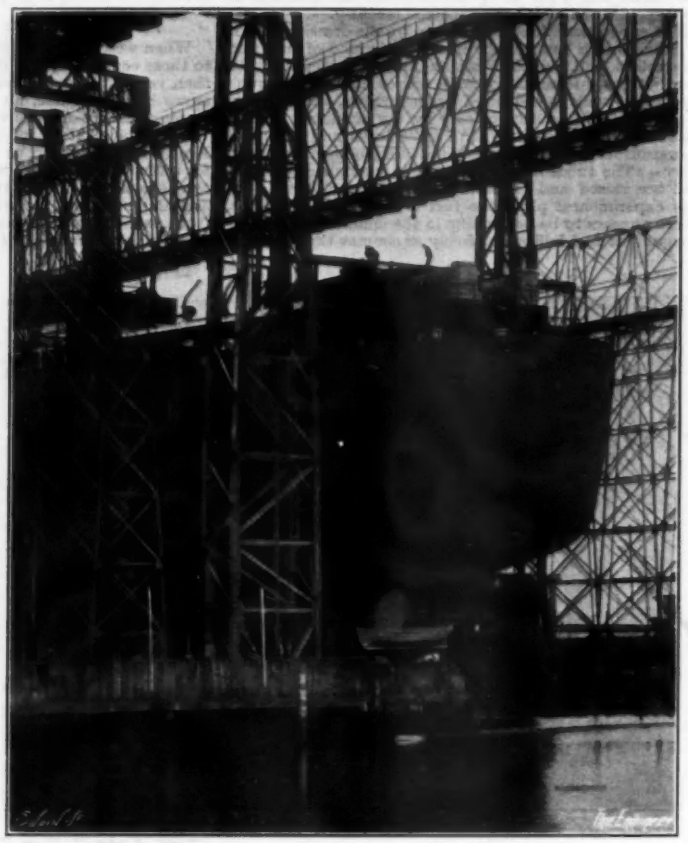
	£		£
Coal—		Fuel—	
72,600 tons at 10s.	36,300	42,900 tons large, at £1	42,900
Operating costs—		4,125 tons nuts, at £1	4,125
Wages, power stores, renewals, depreciation, management, capital, at 6s. 3d. per ton, inclusive of benzol refining	22,688	1,650 tons breeze, at 5s.	400
		Tars—	
		1,056,000 gals. at 4d.	17,600
		Benzol—	
		264,000 gals. at 1s.	13,200
		Gas—	
Balance	22,537	Surplus, 2500 cub. ft. per ton at 5d.	3,300
	£81,525		£81,525

ON a long length of fencing on a road in Pennsylvania the posts have been made of concrete, and on one face they have attached a piece of wood 2in. by 3½in. The attachment is effected by bolts and nuts embedded in the concrete when it is cast. The idea is that the wood provides a convenient means of attaching and renewing the fencing wires.

THE NEW WHITE STAR LINER "BRITANNIC"—BOW AND STERN VIEWS

HARLAND AND WOLFF, LTD., BELFAST, BUILDERS





The Institute of Marine Engineers.

AWARDS.

The Council of the Institute of Marine Engineers desires to draw attention to the various awards which are offered periodically for competition.

The following awards are offered annually :—

(1) The Denny Gold Medal for a paper read by a member during the session ;

(2) The Institute Silver Medal for a paper read by a non-member during the session ;

(3) The John I. Jacobs Memorial Award, value £5, for an essay by a student graduate or graduate on one of the following subjects :—(*a*) Various methods of preventing leakage through glands of either (1) reciprocating engines, of (2) turbines ; (*b*) the methods of lubricating the various moving parts of (1) a Diesel engine, (2) a geared steam turbine, or (3) a reciprocating steam engine ; (*c*) a description of the various mountings on a set of boilers, and the care necessary to be exercised in their manipulation to avoid accidents ; and (*d*) a description of the circulating pump with its duties, including the valves and connections for regular and emergency service.

The following are offered every two years :—

(4) W. Murdoch and D. F. Robertson Combined Award, available this year, value £13, for an essay by an associate, student graduate or graduate on one of the following subjects :—(*a*) The evolution of the valves and mechanism controlling the flow of the working fluid in (1) steam, or (2) internal combustion engines ; (*b*) the erection of machinery in place, giving details of the more usual troubles experienced due to faulty assembly ; (*c*) the steering system of a modern ship ; and (*d*) shop methods suitable for the economical production of a marine steam turbine ; or shop methods of testing a large marine steam turbine.

(5) The Herbert Akroyd Stuart Award, next available in 1931, value approximately £56, open to members of all grades, for the best paper on "The Origin and Development of Heavy Oil Engines," read at the Institute before April 30th, 1932.

The following are offered every three years :—

(6) The Sir Archibald Denny Award, next available in 1932, value £15, for an essay by a sea-going member on "Hints and Deductions from Practical Experience which may be Useful in Improving Ship and Engine Design."

(7) The Stephen Award, value £15, available this year, open to all grades of membership for an essay on one of the following subjects :—(*a*) The conditions that must be observed in the design and layout of the steam pipes on board a ship in order to secure safety, economy, and convenience in use at all times ; (*b*) the auxiliary machinery fitted in a modern vessel ; (*c*) the evaporating plant as fitted, detailing the special points that must be attended to in its design and maintenance to secure the highest efficiency ; (*d*) electric machinery and fittings necessary in the present-day passenger ship ; (*e*) the advantages and disadvantages of the internal combustion engine for marine purposes ; and (*f*) the value of workshop experience, *i.e.*, technical skill in the use of tools, &c., to the engineer at sea.

The Council also desires to make known as widely as possible amongst apprentice and junior engineers the following particulars of the examinations which are conducted annually under the auspices of the Institute :—

Lloyd's Register Scholarships.

These are three in number, one being available each year for three years at £100 per year. They are offered by Lloyd's Register of Shipping. The scholarship is open for competition to candidates who are British subjects, *i.e.*, all who are of British parentage in its Imperial sense, the age limit being from eighteen to twenty-three at the date for entering the university. It is intended to assist marine engineering students to obtain an advanced course of instruction in engineering subjects. Only those are eligible who have served at least two years in a commercial engineering workshop, and until the time of application have been employed in engineering either ashore, afloat or at college, with the intention of entering upon the profession of marine engineering.

Student Graduate Examination.

Engineer apprentices and/or students who have completed one year of their training are eligible as candidates for student graduateship of the Institute. Further information regarding the foregoing may be obtained on application to Mr. James Adamson, Honorary Secretary, the Institute of Marine Engineers, 85–88, The Minories, London, E.C. 3.

New White Star Motor Passenger Liner "Britannic."

The twin-screw motor passenger liner "Britannic," which has been designed and built by Harland and Wolff, Ltd., for the Liverpool-New York service of the White Star Line, and was safely launched from the builders' North Yard, Belfast, on Tuesday last, August 6th, is of special interest, as she is the largest British motor vessel afloat, and will be propelled by two of the highest power unsupercharged marine oil engines yet constructed. In the accompanying engravings we show the bow and stern of the liner as she appeared on the stocks, and a view of the port engine on test in the makers' works.

Hull Construction.—The new liner has been constructed to meet all the requirements of Lloyd's Survey and the Board of Trade, and she embodies a new standard of comfort in the design of her cabin, tourist and third-class passenger accommodation. As will be seen from our illustrations, she has a straight stem and a cruiser stern, being modelled on the newest lines. When completed she will be furnished with two short funnels of the type which we have come to associate with the larger motor vessels recently built at Belfast. Her safety and navigation equipment will embody all the latest devices, and considerable care has been taken with the water-tight subdivision of the ship and the means for fire protection. The double bottom, which runs the whole length of the liner, is subdivided to carry fresh water, water ballast, and fuel oil, while there are bulkhead subdivisions dividing the hull into thirteen separate water-tight compartments. The principal dimensions of the ship are as follows :—Length between perpendiculars, 680ft.; breadth moulded, 82ft.; and depth moulded, 43ft. 9in. Her gross tonnage will be between 26,840 and 27,000.

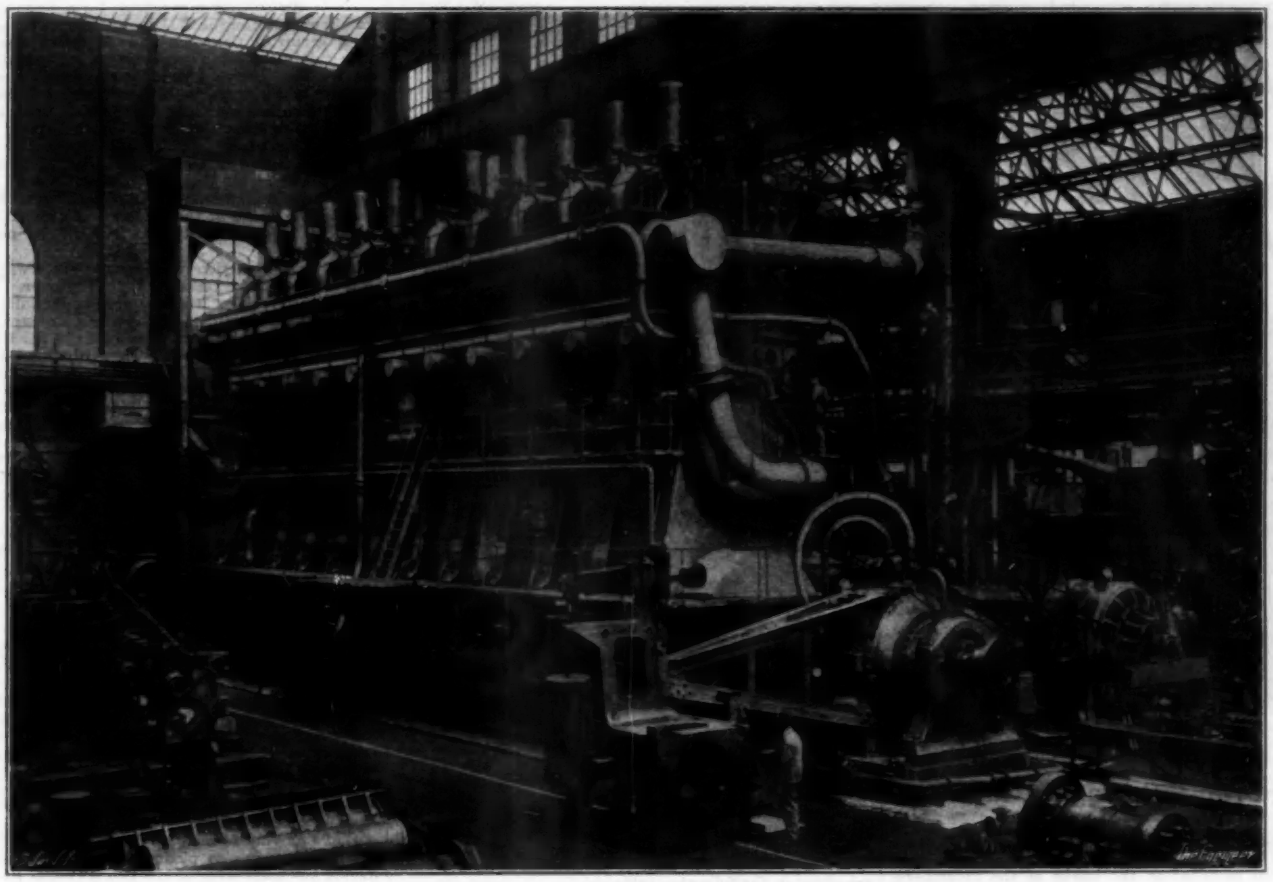
Passenger Accommodation.—Accommodation is provided for no less than 1550 passengers of all classes. The cabin class accommodation includes a number of suites of rooms on "A" deck and a series of other suites and single-berth cabins, and special attention has been given to the artistic design of the alleyways in, and leading to, the passenger quarters. In the principal public rooms, which are mainly on the promenade deck, an effort has been made to eliminate the impression of restricted space. Forward on the promenade deck is the card room, aft of which is the forward staircase and entrance. There is a large lounge, with provision for dancing, and leading from the lounge to the smoking room a long gallery, which can be used as a promenade. The after staircase opens out from this gallery and at this part of the ship there is also a drawing room and a verandah café. The main offices are arranged in the entrance hall on "B" deck, and the dining saloon, which is on the same deck as the main embarkation entrance, is, for the main part of its length, two decks high. There is a swimming pool for cabin class passengers, and very comfortable tourist and third-class public rooms and cabins have been provided, with play rooms for the children of different classes of passengers.

Deck and Auxiliary Machinery.—The main deck machinery includes sixteen electrically-driven winches, the steering gear, along with four large capstans and two large warping winches. The large size of these auxiliaries may be gauged from the fact that the forward capstans are each driven by a 170 B.H.P. motor, and the after capstans by a 100 B.H.P. motor, while a 105 B.H.P. motor is employed to drive each of the warping winches. The whole of the kitchen machinery is electrically operated, and electric lifts are used in all parts of the ship. Ventilation is provided by a system of about seventy-five electrically-driven pressure fans with diameters ranging from 10in. to 55in. In a number of these fans special heating elements have been fitted, which enables the air to be warmed to meet the requirements at any part of the voyage. These air heating fan units are, moreover, supplemented by electrical heating units, which are arranged throughout the passenger accommodation. An interesting domestic service feature is the introduction of a new system of small electric signalling lamps instead of the usual call bell and indicator boards for the cabin services.

Main Propelling Machinery.—The main engines—one which is shown on page 153—recently underwent their shop trials, and ran, we learn, very smoothly and regularly. The designed output of each unit is 10,000 S.H.P., there being ten cylinders to each engine, each having a bore of 840 mm., with a stroke of 1500 mm. They operate on the double-acting four-stroke air-injection principle, and are of the standard Harland-B and W pattern, and embody all the recent improvements in design which we referred to when describing the main engines of the Nelson liner "Highland Monarch"—see The Engineer for October 12th, 1928. The cylinders are arranged for fresh water cooling, and oil cooled pistons are employed. There are four independent injection air compressors, each of which is driven by a four-cylinder trunk-type engine of the Harland B and W pattern. A small steam-driven air compressor for emergency use is also provided. In view of the large amount of electrical equipment in the vessel, the generating plant for both the engine-room auxiliaries and ships' deck machinery has a specially large

10,000 S.H.P. PORT ENGINE OF THE MOTOR VESSEL "BRITANNIC"

HARLAND AND WOLFF, LTD., BELFAST, ENGINEERS



output. It is accommodated in a separate room adjoining the main engine-room, and comprises four oil engine driven generator sets, having a combined capacity of 2000 kW. The engines driving the generators are of the six-cylinder type, and are similar in design to the units employed for the air compressors. There is also a 75 kW oil engine driven emergency generator set placed on the margin line, which, if the main sets are out of action, is sufficient to provide current for the wireless, lighting and lifeboat services. In order to generate the steam required for cooking and heating purposes at sea, four exhaust gas boilers of the "Clarkson" thimble-tube type are fitted, two boilers being fed from the exhaust manifold of each main engine. Each boiler has a designed heating surface of 500 square feet, and is 5ft. 3in. in diameter, with a length of 10ft. They are designed to generate from 2500 lb. to 4000 lb. of steam per hour, according to the load on the engines, at a working steam pressure of 100 lb. per square inch. When in port one exhaust gas boiler of the same type, having a diameter of 4ft. and a length of 10ft., is for use in connection with the auxiliary generator engines. It has a designed output of 1800 lb. of steam at 100 lb. pressure. There are also two oil fuel cylindrical single-ended boilers, which will be available for generating steam in port or at sea for heating and cooking purposes. Work on the "Britannic" was well advanced at the time of her launch, and it is expected that she will take up service next year.

AN ELECTRIC LIFT AT WESTMINSTER CATHEDRAL.

An interesting electric lift has been installed by Marryat and Scott, Ltd., in the Westminster Cathedral for the purpose of conveying visitors to the top of the tower, from which an excellent view can be obtained. Its travel is 180ft. and it is designed for a load of 15 cwt. at a maximum speed of 350ft. per minute. With the exception of the three-phase motor which was supplied by the British Thomson-Houston Company, the whole of the equipment was designed and built by Marryat and Scott's engineering staff.

A special car switch operated by an attendant in the car serves for the control, and a detachable self-centring dead man's handle is provided, the handle forming a key for the inner gate, which must be locked during a journey. The car switch is marked for the up and down journeys and gives fast and slow speeds in either direction. Below the car switch, but integral with it, are two emergency buttons. Momentary pressure applied to one of these buttons replaces the triple-pole circuit breaker if it should open as the result of an overload or earth defect on any one of the phases. The other button is for depression in the event of a defect occurring in the landing locking system, while a journey is being made, the effect of such a defect being to bring the car to rest. Under these conditions a journey can only be made at slow speed, and a red warning light appears behind a lens in the car switch. When the lift is at rest at any floor the red light glows, whilst when the landing and cage gates are closed a green light appears, thus indicating to the attendant—who incidentally is in telephonic communication with the lift motor room and with the porter's entrance lodge in the hall—the normal safe working conditions.

The car is fitted with "governor-operated delay action gradually applied super-type safety gear," which, in the event of overspeeding of the lift cage, first interrupts the supply of current to the motor and then applies grips to the guides, so that the cage and its load are firmly supported on the guides.

The landing gates, in addition to being electrically and mechanically locked so as to make it impossible for a landing gate to be opened unless the car is opposite a floor or for the lift to move unless the gates are closed, are mechanically locked by the closing of the inner cage gate.

The winding engine, motor and controller are situated immediately above the lift shaft, and the drive is transmitted to the car by means of four flexible steel wire ropes in the usual manner. The exceptionally long lifting rope is compensated by a heavy chain anchored at one end at a point approximately halfway up the lift shaft, its free end being connected to the steel work forming the under-carriage of the car. An ingenious scheme has been devised for giving gradual acceleration and deceleration. Acceleration is obtained by a friction drum which rotates the brushes to the fast-speed position in a definite period, whilst deceleration is secured by the return of the brushes to the slow-speed position by a balance weight controlled by a dashpot. In the event of a failure of the current supply the lift may be wound to the nearest floor by hand.

SIXTY YEARS AGO.

In the late 'sixties we gave much attention to the merits and demerits of various types of breech-loading rifles. Invention in that direction was at the time very prolific. It would be a mistake to suppose, however, that even as late as 1869 no one could be found to support the muzzle-loader, in spite of all that had been done and said about the breech-loader. At any rate, it would appear from a note in our issue of August 6th, 1869, that there were still some who required the evidence of a direct test to convince them of the superiority of the newer type of weapon. A convincing trial was afforded them. A squad of fifteen picked men armed with long Enfield muzzle-loading rifles was placed in competition against three men armed with Soper direct-action breech-loaders. Each party was to fire as rapidly as they pleased for three minutes at 200 yards. The muzzle-loaders made a total score of 272. The three breech-loaders scored a total of 388. One of the breech-loaders got off 56 shots in the three minutes. Another actually scored five bull's eyes before a single shot was fired by any of the fifteen breech-loaders. . . . In the same issue Professor Macquorn Rankine began a discussion of "The Dynamical Principles of the Motion of Velocipedes." It was intended to be an elementary explanation of why a two-wheeled machine could be balanced, steered and propelled, a subject on which much curiosity and much ignorance then prevailed. The dynamical principles were correctly expounded, as was to be expected of the author. It is, however, doubtful if he really succeeded in making the explanation clear to many of his readers. It was based on the general principle that the motion of the common centre of mass of a set of bodies cannot be altered by the mutual action of those bodies. That principle is not among the stock of knowledge possessed by the average person even to-day. How, then, could it be expected to provide a convincing demonstration of the motion of a bicycle at a time when, even among engineers, dynamical knowledge was so confused that force, power, *vis viva* and energy were used by many to represent the same thing, when even the simple distinction between stress and strain was, for most, a matter of great difficulty to understand?

DURBAN WATER SUPPLY.

The fact that Durban, within eighteen months of the commissioning of its big water undertaking at Shonweni, should have its water engineer raising the question of a new scheme in another watershed must have come as an unpleasant surprise to its citizens. It also serves as a reminder that, with the exception of Johannesburg and Cape Town, there is not a single one of the larger towns in South Africa which is in a thoroughly sound position as regards water supply. Some have inadequate storage or have been deceived as to river flows; others have sufficient water, but lack the means to bring it to the towns. Where the mains are not too small, they are in a dangerous condition. The major difficulty has been, of course, the niggardliness of Nature in the matter of rainfall or the extremes of climate, which give a feast at one time and a famine at another, flood water being a poor substitute for a perennial stream.

In the case of the Shonweni undertaking, various delays brought the time between the first recognition that a new scheme was required and its commissioning to something like ten years. The Shonweni scheme includes the Vernon Hooper reservoir, with a capacity of 2600 million gallons. The chief feeder is the Umlaas River, with a catchment area of 312 square miles, which is a heavy carrier of silt. The capacity of the scheme was estimated at 20 million gallons per day. Ever since the scheme was commissioned, the catchment area has suffered drought conditions. The borough water engineer has lately reviewed the position in detail in a report, and concludes that under the adverse conditions which have prevailed since the scheme was commissioned, the daily quantity of water which could have been relied upon could not have been more than 13,000,000 gallons. The average daily consumption of Durban rose from 4,016,700 gallons in 1919 to 9,935,500 gallons in 1928, which was an increase of 1,920,000 gallons per day over 1927. "I am bound to contend," says Mr. Campbell in his report, "for the view that the future, in the light of our recent drastic experience, is too speculative to permit of other than definite and express action in the direction of securing absolute assurance, especially when it is borne in mind that it takes some years to carry out a large waterworks scheme."

Shonweni scheme cost the borough just under a million pounds, and was expected to provide for the needs of Durban for many years. As an engineering achievement, it is a splendid success, but it is evident, from what Mr. Campbell reports, that it has been placed in the wrong watershed, the fault being that there were not sufficient records at the time to point that fact out.

A LARGE AIR FILTERING PLANT

A Large Air Filtering Installation.

In the accompanying illustration we show one of three air filters of the "Protectomotor" panel type, which have recently been installed at the works of the Stromberg-Carlson Radio and Telephone Company of Rochester, New York. The total capacity of the filtering installation is 86,400 cubic feet of air per minute, and in all there are 108 panels. The Protectomotor panel type of filter consists of a series of parallel fins made of wire gauze, which are covered by a special felt. A very large filtering area is thus presented, and the units are made in standard sizes which can be built up in a steel frame to meet various duties. In the installation we refer to, the air contains a good deal of dust, which is removed by cleaning the filters with a special vacuum cleaner once every two weeks. The time required for this operation is 1½ hours. The same type of air filter is also made in a series of standardised forms, which have been specially designed for the filtering of inlet air for motor cars and lorry engines, in air compressor and oil engine installations, and in air pipe line systems. In this country all the Protectomotor air filters above referred to are manufactured by C. G. Vokes, Ltd., of 95 and 97, Lower Richmond-road, Putney, S.W. 15.

The Ljungstrom Non-Condensing Turbine Locomotive.

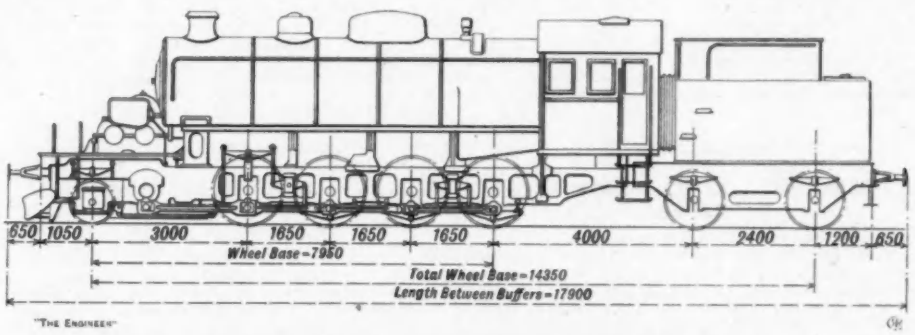
Since the economy of a steam turbine depends so largely upon the provision of a good vacuum, the future of the turbine locomotive has generally been regarded as inseparably connected with the problem of constructing a satisfactory portable condensing plant. That the air-cooled condenser, which was such a notable feature of the first Ljungstrom locomotive, has been retained practically without modification in all the subsequent locomotives built to the designs of the Aktiebolaget Ljungstroms Angturbin is sufficient proof that it fulfilled its purpose, and the question of condensing appeared to be settled so far as the Ljungstrom locomotive was concerned. As we mentioned, however, in our series of articles published during April this year, describing the development of this type of locomotive, the Ljungstrom Company believed, from its experience, that the advantages of the turbine over the reciprocating drive were so great that for certain classes of work the turbine locomotive would prove superior to the piston type, even though the former had not the advantages of condensing. For the same adhesive weight turbine locomotives have shown themselves capable of maintaining a tractive effort about 25 per cent. greater than piston locomotives, the difference being due to the even torque provided by the turbine drive and to the absence of unbalanced forces alternately increasing and diminishing the pressure of the wheels on the rails. This increased tractive effort is of great importance when heavy goods trains have to be hauled, and since careful calculations showed that a saving in fuel of something like 20 per cent. of fuel might be expected as well, even with a non-condensing turbine locomotive, two engines of this type have recently been ordered for mineral traffic by the Oxelösund-Flen-Westmanlands Railway, which is owned by the Trafik Aktiebolaget Grängesberg-Oxelsund, the well-known Swedish iron company. The engines are to be constructed by Messrs. Nydqvist and Holm, of Trollhättan, whose experience of Ljungstrom locomotives includes the building of the engines now in service on the Swedish State Railway and the Argentine State Railway.

The general arrangement of the non-condensing locomotives is shown in the annexed drawing. The turbine, as will be seen, is placed in front of the smoke-box. Triple reduction gearing connects it with a jack shaft from which coupling rods extend backwards, connecting the four pairs of driving wheels. The leading particulars of the machine are given in the following table :—

Particulars of Non-condensing Ljungstrom Locomotives for Mineral Traffic.

Weight of locomotive, empty	91,500 kg.	90·03 tons
Adhesive weight	72,000 kg.	70·84 tons
Weight of locomotive in running order	118,500 kg.	116·68 tons
Weight of water carried	15,000 kg.	14·76 tons
Weight of coal carried	5000 kg.	4·92 tons
Maximum speed	60 km.p.h.	37·28 m.p.h.
Length over buffers	17,900 mm.	58·73ft.
Total wheel base	14,350 mm.	47·07ft.
Tractive effort by adhesion	21,500 kg.	21·11 tons
Diameter of driving wheels	1350 mm.	53·15in.
Boiler pressure	13 atm.	185 lb. gauge
Steam temperature	400 deg. C.	752 deg. F.
Boiler heating surface	150·2 m².	1618 sq. ft.
Superheater surface	100·0 m².	1076 sq. ft.
Grate area	3·0 m².	32·3 sq. ft.
Steam pressure at turbine inlet	11·5 atm.	163·6 lb. ga'ge
Exhaust pressure	0·4 atm.	5·7 lb. gauge

From experience gained with the turbines and gearing of Ljungstrom condensing locomotives it is anticipated that the maintenance costs of the non-condensing locomotives will be considerably less than those of piston locomotives for equal duty, while the first cost of the machines is no higher. The absence of condensing allows the turbine exhaust to be used to create a draught in the usual way, thus avoiding the special draught fan necessary in an ordinary condensing turbine locomotive.



Ljungstrom Non-Condensing Locomotive—Weight Diagram

Accumulation of Caddis fly larvæ on the walls of flumes and tunnels carrying water to certain hydro-electric plants of the Southern California Edison Company causes such a serious decrease in the capacity of the conduits that annual removal is necessary. The larvæ form a slimy coating that is reported to reduce the capacity of a 620 cusec. conduit as much as 40 cusecs. Cleaning of the larger size conduits requires shutting off the flow to permit workmen to scrape off the deposit. Smaller pipe lines are successfully cleaned by forcing oak brush balls through the pipe by water pressure.

Canadian Engineering News.

(From our own Correspondent.)

Gigantic Power and Waterway Plan.

An entirely new scheme for a gigantic power and waterway canal on the St. Lawrence River is being fostered by a group of Canadian and American financiers, who have submitted their proposals to the Canadian Government. The proposed canal would be in three sections, two in Ontario and one in the Province of Quebec. Five locks would replace the present twenty-two locks on the St. Lawrence Canals. The first section would be an open-mouthed waterway on the north-west side of the St. Lawrence, with a lock at the lower end, of the same dimensions as those on the new Welland Canal. The canal would have a minimum depth of not less than 30ft., with a waterline width at the entrance of not less than 700ft., while at the narrowest point it would be not less than 300ft. wide.

The second section would be a waterway of similar dimensions, on the Ontario side of the river. In the third section of the project, the company would build a waterway of the same dimensions as the other two sections, from a point at or near Hungary Bay on Lake St. Francis as far as the Chateauguay River. There, the land drops, and to maintain the Lake St. Francis level embankments would be constructed to a height of 54ft. and 2200ft. apart in order to create a reservoir. This section would be on the south side of the St. Lawrence, within the Province of Quebec, and would be about 35 miles in length. With each of the other sections running about 14 miles, the total canalisation projected is in the neighbourhood of 63 miles, all of a size to permit navigation by the large freighters of the upper lakes. The promoters of the project propose to give these waterways to Canada without charge or expense whatever and free of any bonded indebtedness, since the financing would be predicated entirely on power revenues.

West Kootenay Power to Expand.

The West Kootenay Power Company has drawn up an ambitious programme for the expansion of its hydro-electric plants in British Columbia. The principal scheme involves the damming of Kootenay Lake at its outlet. The proposed dam would add greatly to the output of the company's power plant at Bonnington, which has a capacity of 150,000 horse-power, thus ranking as one of Western Canada's greatest electrical producers. During the winter, however, this output is sometimes reduced to half the maximum by lack of sufficient head of water when Kootenay Lake is low.

While moving to increase its production at Bonnington, the company is also planning two other major developments, the harnessing of the Pen d'Oreille River near the United States boundary, a project of first magnitude, and the development of a smaller 25,000 horse-power plant on the Adams River east of Kamloops. The importance of the latter scheme lies in the fact that the new plant will be tied into the company's main wires from Bonnington Falls *vid* Kelowna, and its electricity will then be used largely to supply mines in the Princeton district.

Mechanical Equipment for Fighting Forest Fires.

At the time of the 1923 British Empire Forestry Conference in Canada the use of mechanical transport and of power pumps for fire-fighting was just coming into prominence. In the intervening period great progress has been made in this direction. Automobiles and trucks are no longer specialities, but are considered necessary stock equipment of all forest fire-fighting organisations. Similarly, portable petrol fire-pumps are now available for use on practically any fire where water is available. The efficiency of these pumps has been greatly increased and the weight appreciably reduced. Models of various capacities are now used for different occasions, very light pumps for rough inaccessible regions and larger, more powerful units for positions which can be reached by road or trail. New devices are constantly being given attention, all testifying to the thought and effort being put into fire control. In general, it may be said that forest fire-fighting in Canada is becoming more and more a specialised science involving the use of every possible mechanical facility.

Treatment of Copper Concentrates in Canada.

Arrangements are being made by the Sheritt-Gordon Mines, Ltd., for the smelting and refining in Canada of the ores from the big copper-zinc-gold-silver property in Northern Ontario. The smelter being erected at Flin Flon, Manitoba, will treat the copper concentrates, and the blister copper produced there is to be refined at Sudbury, Ontario, while zinc concentrates will be treated at the new electrolytic zinc plant to be erected by Ventures, Ltd., and the Consolidated Mining and Smelting Company, in Eastern Canada. Arrangements have also been made

for electrical power for the mining and concentrating of Sheritt-Gordon ores, the power to be furnished from the new hydro-electric station under construction at Island Falls on the Churchill River.

Iron and Steel Research.

For the purpose of research work in the iron and steel industry of Canada, the Department of Mines has erected in Ottawa, as an addition to its present ore-testing laboratories, a new pyrometallurgical laboratory, which is being equipped with laboratory scale and semi-commercial roasting, calcining, sintering, metallising, melting, heat-treating, and standard laboratory testing and metallographic equipment for conducting extensive test and research on ferrous and non-ferrous ores and their alloys.

Large Oil Tank.

Plans for the construction of the largest oil tank in British Columbia have been completed, and the work will be started immediately at Port Mann, for the Imperial Oil Company. The tank will be for crude oil, which will be shipped from the company's plant at Ioco, near Vancouver, and from the United States, in tank steamers to the new storage tank wharf on the Fraser River. Tank cars will be filled at Port Mann for transmission to all points in British Columbia and Alberta.

Large Water Storage Project.

As the initial step in its great scheme for developing approximately 700,000 horse-power of hydro-electric energy on the upper St. Maurice River, in the Province of Quebec, the Shawinigan Water and Power Company, of Shawinigan Falls, has completed arrangements for the early construction of a large storage reservoir near St. Michel des Saints, on the Mattawin River, one of the most important tributaries of the St. Maurice. In anticipation of the completion of this project in 1930, the company is already arranging for the installation of an additional unit in each of its three projected plants on the upper St. Maurice, which units will have a combined capacity of over 100,000 horse-power. At the time the Shawinigan Company obtained the rights on the upper St. Maurice, it was estimated that the development of the various rapids would mean an additional supply of power for that company of over 600,000 horse-power. The Mattawin project will cost about 4,000,000 dollars. The company recently commenced the construction of a transmission line from Shawinigan Falls to La Tuque, which will eventually connect with the first development on the St. Maurice. The new line will have an ultimate capacity of 100,000 horse-power. For almost a year the company has been making surveys both on land and from the air of the St. Maurice River, and it tributaries, with a view to determining the most suitable sites for development.

British Columbia Firms Compete for Power Rights.

Big industrial concerns in the Province of British Columbia are exhibiting unprecedented rivalry for the remaining important undeveloped water power sites on the Pacific Coast. The latest move in that direction is in what is known as the Stillwater district, where the Powell River Company and the Consolidated Mining and Smelting Company are in competition for power rights on the Lois River and the Gordon Pasha Lakes. The Powell River Company is anxious to obtain these rights in order to increase the power supply of its great pulp and paper mill just to the north of the Lois River. Both companies have schemes for development which are almost similar, the Consolidated Company applying for a licence to take and use 800 cubic feet per second and to store 500,000 acre feet of water out of Lois River in certain tributary lakes. The application of the Powell River Company is for 1000 cubic feet of water per second and 630,000 acre feet of storage. The records of the Provincial Water Board indicate that Lois River and the Gordon Pasha Lakes can be dammed to yield from 20,000 to 25,000 horse-power.

Canada's Progress in Electrical Development.

According to figures recently published by the Water Power Branch of the Dominion Government, more than 15,700,000,000 kWh of electric energy were used in Canada in 1928, which was two and one-third times the amount used in 1922. The increase in consumption which has taken place since the war is indicated in the statement that whereas in 1912, 1,500,000 horse-power was being absorbed, that amount had doubled by 1922, and during the last year the consumption exceeded 5,300,000 horse-power. Nor has this development been confined to one specific section of the country; construction in power plants extends from coast to coast, and schemes for the future are equally widespread. During 1928, hydraulic turbines aggregating 550,000 H.P., bringing the total up to 5,349,232 H.P., were installed. It should not be thought that this large increase in hydro-power is solely the result of demands on the part of mining and pulp mills, because 83·01 per cent. of the installation has been utilised for public distribution. Ten per cent. is used in the power plants of pulp and paper mills, and 6·2 per cent. has been required by industrial and mining companies.

Aerial Photography Expanding.

One of the outstanding features of a survey of the natural resources of British Columbia this summer will be the extensive utilisation of aerial photography. The authorities point out that by the adoption of this method, a map of the entire district may be completed in one summer, whereas under ordinary procedure it would take several seasons to complete the task. The decision of the Provincial Government and the two major railway companies to employ planes in their work is a criterion of the rapid strides Canada has made in this direction. A further indication of the magnitude of the proposed survey is afforded by the fact that, in addition to the use of airplanes, eight parties of British Columbia land surveyors will be engaged in the work throughout the summer.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

On Holidays.

Nearly all the Midland and Staffordshire works have been idle this week, and employers and employees have been holiday making. In a few instances work was resumed at mid-week, but most of the mills rested the whole of the week. In many branches of the engineering and manufacturing industries there are prospects of reasonably good running for plant when the machinery in put in motion again, while iron and steelmasters have good order books which ensure a regular output for some months to come. New orders for material are expected to be small though regular until the autumn buying movement sets in about October, but, generally speaking, the position gives cause for considerably less anxiety than is usually the case at this period of the year. Some concern is felt at the Government's attitude regarding naval building, for many Midland industries are closely allied to the shipyards, supplying materials, engines and fittings. Any action the Government may take respecting the McKenna Duties and the Safeguarding of Industries Act is bound to have a considerable effect upon Midland industries, and it is from this direction that manufacturers and engineers anticipate their chief worries will come. The industrial fuel situation also causes some trepidation, but is expected to improve in the near future. Coke prices are at date very high and advancing; selling prices of raw iron indicate the probability of dearer finished material and goods.

Staffordshire Bar Iron.

Staffordshire iron mills will recommence operations on Monday with good order books and reasonably bright prospects. Despite the increase in cost of raw materials producers of marked bars have not departed from the basis of £12 fixed sixteen months ago. The trade, with the assistance of staple selling prices, has developed and now enjoys a fair measure of prosperity. Makers hesitate to do anything which might act as a deterrent to the trade improvement. In the Crown bar department also there has been some improvement in demand, but internal competition has been severely felt by local ironmasters. They continue to quote £10 to £10 5s. per ton for their iron in spite of the low prices accepted by makers in other districts, and they secure a fair proportion of the business available, not on price but on quality. Nut and bolt iron remains in poor request, as does fencing iron. Wrought iron tube strip moving in sympathy with pig iron is dearer at £11 2s. 6d. per ton.

Pig Iron.

There has been little business done in pig iron since my last letter, and the ultimate result of the recent advance in the basis price is yet to be learned. It is felt that the market will not be seriously affected, however, for large consumers are already well covered for the third quarter of the year. The foundries are calling for better supplies for light castings, and it seems probable that pig iron bought on the open market will have to be paid for at furnacemen's prices. Furnace coke is, if anything, dearer, ovenmen now asking up to 16s. 6d. per ton. Until there is a more abundant supply of coke, it is asserted raw iron prices will be maintained. Midland furnacemen say they are no better off as regards profits than before prices were raised. The increased cost of production has wiped out any advantages which might have accrued to smelters. There is a certain amount of Northamptonshire foundry iron still going to the North-East Coast for consumption. This month is bound to be a quiet one in the raw iron department of the market.

Steel.

The position in the steel trade is unchanged, but prospects in the heavy department for the autumn are improving, structural engineers and rolling stock builders reporting a revival of inquiry. Finished steel prices are maintained at recent levels, but rumours of pending advances continue in circulation. In the lighter classes of steel continental competition is keen, and foreign prices in some instances offer considerable advantages to local manufacturers. Native rollers of small bars are no longer able to keep prices up to the £8 5s. level, while billet makers are inclined to consider slightly lower prices than those recently considered acceptable. English billets are nevertheless still quoted £6 10s. and Welsh billets £6 7s. 6d. Foreign steel strip at £7 5s. is in good demand, the price comparing with £8 2s. 6d. minimum to £8 10s. required for native steel strip. Heavy steel scrap does not sell so freely as of late, and Birmingham merchants are willing to supply South Wales at £3 17s. 6d.

Galvanised Sheets.

The basis of £13 7s. 6d. for twenty-four gauge galvanised corrugated sheets still holds good, though cheaper spelter affords makers some relief in production costs. Many local mills would be glad to replenish their order books, which are now getting scanty. They are looking for a revival of demand from the Indian market. Meanwhile they are just able to carry on regularly.

Cotton Stoppage Affects Courtaulds.

Owing to the cotton stoppage Courtaulds, Ltd., has found it necessary to close down temporarily its silk factory at Nuneaton, its Coventry mills at Leigh, and a factory at Holywell. The factory at Wolverhampton and two other mills at Leigh are up to the time of writing continuing operations. The firm states that the bulk of its processed yarn is sent to Lancashire, and owing to the stoppage in the cotton industry, it is compelled to close down its processing factories temporarily.

Suggested Merger of Motor Engineering Firms.

Midland engineering firms are associated with the extensive motor trade amalgamation just now under discussion, but as the negotiations have not yet reached beyond the preliminary stage, the officials of the Birmingham, Coventry and Dudley firms, the names of which are mentioned, are reluctant to supply details or to discuss the matter. It is understood, however, that the suggestion before the firms is the pooling of resources for the production of two types of car, one a 10 H.P. machine for the British market, and the other a 20 H.P. suitable for both the home and Empire markets. Preliminary soundings have not, I understand, been confined to the firms now taking part in the negotiations. The project, if successfully put through, will involve capital amounting to some £2,000,000.

The Tube Trade.

Business is bright in the tube trade and Black Country works are regularly employed. In the weldless steel tube section the motor trade continues to find a good deal of work, and some appreciable orders are coming from the home railways in connection with the reconditioning of old locomotives and the building of new ones. A continuance of prosperity is looked for. In the Walsall area one of the tube works recently took on a number of additional men, while another firm anticipate putting on a fairly large number immediately after the holidays, which in this industry will not be protracted.

Iron Castings.

Manufacturers of light iron castings in this area are fairly well placed for business, and when work is resumed will recommence activity on parts for electric apparatus, automobiles and general engineering ordered before the vacation. Some good orders are expected to develop in the near future, and prospects for this side of the industry are good. The call for malleable grey castings is not so satisfactory, and in this and some other departments of founding the future is somewhat obscure.

Cannock Chase Coal Losses.

In the month of June there was a loss of 1s. 4·47d. on every ton of coal produced in the Cannock Chase coalfield. In the three previous months the losses were respectively 1s. 9d., 1s. 1d., and 1s. 4d. per ton. The owners accumulated deficit, which was £935,610 a month ago, is now £979,886. Wages of miners during August will remain, as in the previous month, at the minimum rate of 42 per cent. on the 1911 basis, although the ability of the industry to pay is only 11·55 per cent. The minimum wage of stallmen now stands at 9s. 4d. per day. Most of the collieries in the Cannock Chase area, on account of the poor demand for fuel, have been idle during the whole of this week. Prior to the holidays many of the pits were only working two or three days per week, and the prospects are not at all rosy. September should, however, infuse more life into the industry.

Tramcar Contract.

The London County Council has given to the Electro-Mechanical Brake Company, of West Bromwich, an order to supply 100 complete tramcar sets. The order is of the value of nearly £25,000.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

Road and Bridge Developments.

Road and bridge construction schemes in various stages of advancement have been prominent during the past week, and expenditure in Lancashire within the next year or two promises to be very heavy. On the undertaking of the Ministry of Transport to grant 75 per cent. of the cost if the work is proceeded with immediately to help to relieve the unemployment problem, the County Council has decided to sanction increased expenditure on roads and bridges from £600,000 to £1,500,000. Alderman J. Aspell, chairman of the Main Roads and Bridges Committee, states that employment will be provided for about 2500 men for eighteen months or two years. Of the above sum, £200,000 represents expenditure which the Ministry has sanctioned for the widening and reconstruction of bridges which belong to railway and canal companies, and for which the companies have limited responsibility. Also as an unemployment relief measure the Manchester Corporation Town Planning Committee has just approved a road construction programme which is estimated to cost about £1,250,000, and provided the Ministry of Transport will contribute 60 per cent. of the cost, is prepared to recommend the schemes to the City Council for acceptance.

Spanning the Canal.

Much as the Manchester Ship Canal has contributed to Lancashire's industrial development, it has also contributed in like measure to the traffic problems of certain areas which flank it. One of the chief causes is the fewness of the bridges spanning the Canal, and the fact that of the four existing bridges between the Manchester end and Warrington three are of the swing type. When these are open to permit the passage of shipping, particularly at Barton, which is a few miles out of Manchester and the only westerly approach over the Canal to the Trafford Park Estate, a thriving industrial centre, traffic congestion becomes a real and serious problem. A suggestion now before the local authorities directly affected—Salford, Barton-on-Irwell, and Stretford, and, of course, the Lancashire County Council—is to construct a new road and a high level bridge to relieve the existing road. The scheme has been approved by the authorities at Barton, and if, and when, the others give their approval, it will be submitted to the Ministry of Transport with an application for a grant of 75 per cent. of the cost of the work as an unemployment scheme. No details of the bridge construction have yet been made public, but it is

understood that the cost of the bridge will be about £100,000.

Loan or Reserves?

At the last meeting of the Manchester City Council a proposal of the Tramways Committee that £110,000 should be borrowed for the purchase of new double-deck motor-omnibuses to replace tramcars on a circular route outside the city was referred back for further consideration to a joint meeting of the Finance Committee and the Tramways Committee on the ground that the money should be taken from the Tramways Department's renewals fund, which stands at about £300,000. In a joint report now issued by the two committees it is pointed out that the department is now spending on renewals about £100,000 more annually than is being placed in the account, and that at the present rate, unless special provision is made, the fund will be exhausted in about three years. The original proposal of the Tramways Committee that the expenditure of £110,000 should be paid for out of borrowed money now has the support of the Finance Committee in a joint recommendation to that effect.

New Refuse Disposal Plant.

A new separation plant for the treatment of refuse, which has been installed by Petrie and McNaught, Ltd., Rochdale, at the Water-street depôt of the Manchester Corporation Cleansing Department, has been formally opened by the Lord Mayor, Colonel Westcott. The claims made for the process are that the treatment of the refuse is mechanical, that it is practically dustless, that all saleable materials are efficiently salvaged, and that on the cost of refuse treatment alone it is estimated that the new installation will effect a saving of about 2s. 6d. a ton. The plant at present is capable of dealing with 120 tons of refuse material in eight hours, with provision for extending the capacity to 360 tons.

Non-ferrous Metals.

In spite of the fact that both tin and spelter are both fractionally lower on balance for the week, one seems to be justified at the moment in describing the non-ferrous metals generally as reasonably steady. Holiday influences during the past week have, of course, been at work, but allowing for that factor, the demand, except in one section, appears to be displaying an improving tendency. Following upon the advances of the two previous weeks, copper has again recovered some ground, and at current levels prices are better than they have been since the end of June. Forward buying transactions are still very cautious, but there has been rather more business passing of late in spot metal. Tin has given way a little compared with a week ago, but it has only been to the extent of a few shillings, and represents nothing more than a minor market fluctuation. Statistical pointers seem to favour a firm market for the time being, and consumers of the metal are showing a fair amount of buying interest. Spelter continues in slow demand, but prices are not much lower on balance. In the case of lead, following last week's rise of 5s., quotations have registered a further substantial recovery of 10s. and more buying has been going on.

Iron and Steel.

Both iron and steel this week have had a seasonally slack spell. In the case of the former, contract deliveries have shown some contraction from the recent relatively high level, and fresh orders have been very few and for a limited tonnage. More or less quiet conditions are expected to rule throughout the present month, and probably half-way through September. Meanwhile, Staffordshire No. 3 pig iron for delivery in the Manchester zone is maintained at 75s. 6d. per ton, and Derbyshire at 74s. 6d., with Scottish brands firm at up to 92s. 6d., and West Coast hematite iron at about 87s. 6d., both delivered in Manchester. Lancashire bar iron is quiet but steady at £10 15s. for Crown bars and £9 15s. for seconds. Deliveries of constructional varieties of steel this week have been rather slow on the whole, but fair contract deliveries in certain sections of the market, notably in small bright-drawing bars and in frame and boiler plate for locomotive work, have been reported. Joists are quoted at £8 2s. 6d.; tank plates at £8 17s. 6d.; boiler plates at about £9 17s. 6d.; large bars at £9 2s. 6d.; and small re-rolled bars at from £8 2s. 6d. to £8 5s. per ton. Foreign steel bars have recovered ground to the extent of about 2s. a ton, but other varieties of imported material are unchanged at the lower levels, and the demand all round on this market is quiet.

BARROW-IN-FURNESS.

Hematite.

As far as the pig iron trade of this district is concerned there is a distinctly better tone. Buyers are showing a tendency to place orders further ahead, and some are booked to cover the first few months of next year. The general home demand is more robust, and despite the fact that the requirements of local steel producers are less marked the demand is increasing. Conditions may lead to another furnace being put in blast, and it is rumoured that producing will start at the Moss Bay Ironworks, Cumberland, which have been very thoroughly overhauled. The foreign trade continues to be fair, and there is a slight improvement noticeable in regards to continental trade. France is taking more, and shipments abroad are increasing. Business with America continues in special qualities and is likely to, but it will fluctuate. The iron ore trade is a little better owing to outside business, and if another furnace goes in in this district this will mean more activity locally. Foreign ore continues to be in steady demand, with a slightly better outlook. The steel trade is not very bright, and in Cumberland there are idle periods. At Barrow there is a better condition to report, but the mills are not at full capacity by any means. Business in hoops keeps this special mill well employed, and there is a steady trade in small bars of special quality.

SHEFFIELD.

(From our own Correspondent.)

Increased Production of Steel.

Although the latest figures of steel production for the Sheffield district show a falling off as compared with the immediate past, they also indicate the extent to which trade is better than it was at the same time last year. The Sheffield Chamber of Commerce *Journal* states that the output in the area is about 1000 tons per week above the rate of twelve months ago. In the month of June, as shown by the official returns, it was considerably more than that, the figures being respectively 86,200 tons this year and 74,300 tons last year. June, however, showed a noticeable decline as compared with May of this year, when the production reached 105,400 tons. The basic side of the steel producing industry is still much stronger than the acid, the quantities for June being 43,700 tons and 32,800 tons respectively. The Lincolnshire output of basic steel in June was 63,200 tons, as compared with 65,500 in May and 39,600 in June of last year. The quantity of pig iron produced in the Lincolnshire area was 75,600 tons, as against 76,000 tons in May and 59,800 tons in June, 1928.

State of the Industry.

The stoppage of the works for the Bank Holiday period was of normal duration. One big firm closed down for a week, as it usually does in August, but most of the others shut down for two or three days only. The open-hearth furnaces continued running throughout the holiday, except at one large works, at which stocktaking is in progress. The general state of trade is, however, much quieter than usual at this time of the year. Business in ordinary commercial lines of steel has fallen off, and while the export trade is poor there are increasing imports of certain classes of foreign material, which are being offered at lower prices. The dispute in the cotton trade has interfered with steel prospects, and another adverse influence is the suspension of naval construction. There has been an advance of 2s. 6d. per ton in the price of foundry pig iron, owing to costs of production and scarcity of material, and the rise is unwelcome to the consumers, who fear it will increase their difficulties in obtaining orders. The branches producing stainless and non-corrodible steels, stampings and alloy steels for the automobile industry are still among the brightest spots in the situation. Improvement is reported in the wire and wire rope trades. The output of British wire rods in May reached 23,700 tons, which was the largest figure recorded for many years. The monthly average for the last few years varied from 16,800 to 19,400 tons. The recent increase in the price of tungsten has been maintained, and unless there is some move in the opposite direction there is probability that selling prices of high-speed steel may have to be raised.

Railway Orders and Prospects.

An order for four bogie dining cars for the Rhodesian Railway has been secured by Cravens Railway Carriage and Wagon Company, Ltd., of Sheffield. Each car will be about 60ft. long, will weigh approximately 40 tons, and will include a dining saloon, kitchen, pantry, refrigerator and larder. It is understood that northern manufacturers may share extensively in the benefits conferred by an expenditure of £1,000,000 which the Great Western Railway Company has decided to undertake in order to carry out various improvements, including the provision of 100 new engines, the conversion of gas-lit coaches to electric lighting, dock modernisation in South Wales, and the enlargement of freight facilities in the London area. There is also hope for local trade in the announcement that the Madras and Southern Mahratta Railway Company is in the market for spare parts for carriages and wagons, including brackets, draw-bars, buffer heads, and casings, coupling hooks, &c., in addition to 1250 tires for carriages and wagons, 2184 axle-boxes for carriages and wagons, and 16,734 steel boiler and flue tubes. The Bengal-Nagpur Railway Company is inquiring for 596 steel boiler tubes. In connection with the fusion of Henry Bessemer and Co., Ltd., of Sheffield, and John Baker and Co., Ltd., of Rotherham, it has been decided that the manufacture of the railway materials in which the two firms have specialised for many years shall mainly be concentrated at the Kilnhurst Works of Messrs. Baker, and to this end some of the Bessemer plant will be removed from Sheffield to Kilnhurst. It is probable that the re-organisation will be carried further and will include the removal of the Brinsworth plant of John Baker and Co. to Kilnhurst, but this step will be gradual and is not likely to be completed for some few years.

Lighter Trades.

There is a good demand from London for best silverware, and it is reported that American tourists are buying considerably, but trade with the provinces is very depressed. Reports from the cutlery and plate branches generally are unfavourable. The output of stainless knives continues large, but profits are very limited. Firms which maintain a good standard of quality, pursue up-to-date methods, and keep prices moderate are able to trade on a satisfactory basis. Trade in farm implements and gardening tools is proving unsatisfactory owing to the drought, and it is feared that dealers will be left with considerable quantities on their hands. The Board of Trade last week heard an application for an order for the marking of imported tools with indications of origin. There was no opposition. Most of the witnesses were from Sheffield, and the case for the applicants was conducted by Mr. R. H. C. Ward, who is the secretary in Sheffield for the National Union of Manufacturers. The file trade has been quiet all this year, and shows no improvement. Somewhat brighter conditions have been caused at some works by Russian orders, but these have been few in number, and business with that country is on a very small scale compared with that of pre-war times. Sheffield produces circular saws of all sizes and for all manner of purposes, and the Chamber of Commerce *Journal* reports a striking illustration, showing two extreme sizes, which a local firm has just published. One of the saws measures 78in. in diameter and weighs 330 lb.; the other, used for slitting mica in the electrical industry, is only ¼in. in diameter, and it takes fifty of them to weigh 1 lb. The material contained in the former would make 16,000 of the latter, and while the larger saw would form an ample roof for a summer-house, the smaller would just cover the unsharpened end of a lead pencil.

Great Ship Canal Scheme.

An important project for the construction of a West Riding ship canal has been launched at a representative conference called by the Lord Mayor of Leeds. The proposal is that the canal shall be suitable for ocean-going vessels and shall connect Goole and Leeds, which are 35 miles apart. Owing to the flat nature of the country, no insuperable engineering difficulties are anticipated. The conference elected a committee of inquiry to obtain information and evidence and report to a future meeting. If the scheme is adopted one of the first steps will be to secure the support and assistance of Government, without which, it is recognised, the West Riding could not undertake a project of such magnitude. The estimated cost is £10,000,000.

Hull Projects.

A number of important projects, industrial and municipal, are before the city of Hull just now. There is a good prospect of the papermaking industry being established on a large scale, for Mr. William Harrison, chairman of the Inveresk Paper Mills, Ltd., has provisionally secured a site of nearly 50 acres, near to the main docks of the Humber, between the city and Hedon. Certain terms remain to be confirmed by the Corporation, but it is understood that these, which relate to the supply of water, have been provisionally agreed with the Lord Mayor and other municipal representatives. Mr. Harrison has stated that if the factory is established Hull will become the largest centre for papermaking in this country and probably in Europe. A step forward has been taken in the scheme for the abolition of the level crossings of Hull, the City Council having formally approved it, subject, however, to confirmation by the consulting engineers who are to be retained to advise the Corporation; to terms of agreement with the London and North-Eastern Railway Company to be agreed; and to satisfactory financial assistance being forthcoming from the Government. The estimated cost of the scheme is £1,220,600. The City Council has also decided to enter into negotiations with the L.N.E.R. Company with a view to the acquisition of the Queen's Dock Estate. The scheme is to fill up the dock, thereby adding 50,000 square yards of land to the centre of the city, which would be utilised for the provision of two or three new connecting thoroughfares from east to west, for public gardens, and for building purposes.

Important Road Schemes.

At several places in this area large road schemes are under consideration. Derby Corporation has decided to seek Government assistance for three large undertakings, the total estimated cost of which is no less than £385,000. The proposals are to make a by-pass road from Alvaston to Nottingham-road; a road from Uttoxeter-road, crossing Ashbourne-road and Duffield-road; and a by-pass road from Deadman's-lane, which would join the first-mentioned road. All the roads are to be 100ft. wide. Notts. County Council has adopted a scheme for the widening of the Great North Road in the county to 30ft. This will cost £250,000. The Highways Committee report that the Ministry of Transport will agree to the work being spread over three years, and will contribute £187,500, leaving the County Council to find £62,500, which latter sum, allowing for the ordinary cost of maintaining the road during the three years, would mean an additional expenditure of only £40,000. York City Council has decided to submit to the Ministry of Transport a scheme of road and bridge work to cost £240,000, spread over five years, and to ask what grant the Government would be prepared to make towards it.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

The holiday month of August promises to maintain its reputation for market inactivity. Business, just at present, is very limited, and, apart from seasonal quietness, an unwelcome undertone of uncertainty prevails in commercial circles. A feeling appears to be growing that grounds for optimism are less solid than of late. Producers, however, are well sold, and activity at works is assured for the next few months. Values are not quotably altered, but prices of one or two commodities are undoubtedly less firm than they have been, while, on the other hand, quotations for some descriptions of material are inclined to stiffen. The fall of year needs on home account promise to necessitate substantial autumn buying, but prospect of expansion of export trade is none too bright.

Cleveland Iron Trade.

There are no new features of moment in the Cleveland pig iron trade. Supplies for August delivery are all but unpurchasable. Any prompt parcels that come on to the market readily realise high figures, but both ironmasters and merchants are offering quantities freely for delivery ahead, and recent sales include contracts for delivery to home firms over periods extending to the end of the year. No. 1 Cleveland foundry iron is 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

A firmer feeling is noticeable in the East Coast hematite pig iron trade, notwithstanding increased output, but quotations are still well below cost of production. Both home and continental consumers are in the market

to buy. Makers have next to no prompt iron to offer, and merchants are by no means keen sellers at rates obtainable. Customers claim that they can place orders with second-hands at 75s. for ordinary qualities, but producers are holding out for 76s., and they declare that the economic figure is in the neighbourhood of 80s.

Ironmaking Materials.

There is virtually no foreign ore for sale, and imports against running contracts fall vastly below the quantities required to satisfy consumers, some of whom are greatly inconvenienced by shortage of supply. Nominally best Rubio is 24s. 9d. per ton c.i.f. Tees. Blast-furnace coke is scarce. Good average qualities are quite 21s. 6d. per ton delivered at works on the North-East Coast.

Manufactured Iron and Steel.

In the semi-finished iron and steel departments tonnage output is heavy, and business continues on quite a good scale, although in one or two of the consuming branches of trade quantities required are not quite so large as of late. Manufacturers of finished iron are turning out a lot of work, and have contracts that will keep them busy for some time. Finished steel producers have little cause for complaint so far as order books are concerned, but improvement in sales and in prices would be welcome. Quotations, all round, are steadily firm.

Iron and Steel Imports.

There was a further contraction in the exports of pig iron from the river Tees during July consequent upon makers having to refuse foreign business owing to the heavy consumption of iron in the local steel works. Last month the shipments of pig iron totalled only 19,366 tons, as against 24,182 tons in June and 32,718 tons in May. There was, however, a substantial increase in the exports of manufactured iron and steel, which reached 69,791 tons, compared with 64,373 tons in June. Belgium was the biggest customer for pig iron with 4668 tons, while Italy received 1690 tons, France 1245 tons, and Germany 1050 tons. South Africa took 14,186 tons of manufactured iron and steel; India, 7626 tons; Argentine, 4030 tons; Natal, 2963 tons; and the Straits Settlements, 2317 tons.

The Coal Trade.

The August position for all sections of the Northern coal market shows a fairly cheerful tone. The recent enhanced tonnage supply has relieved shippers of all anxiety as to prompt clearance of their commitments, and with the lower freight rates it has encouraged a free chartering movement. Coal orders are numerous for the next two or three weeks. Steams, best gas coal and best bunkers are all in keen inquiry. Coking coal and some of the secondary types of Durham fuel, however, are not nearly so well placed and offer room for additional trade. Firm prices are indicated for Northumberland steams, but they are stationary and show no pronounced tendency to improve. Best steams range from 15s. 3d. to 15s. 6d., but there are not many sellers. Tyne primes keep to 14s. 6d., and second steams to 14s. There is a ready market for the output of small steams, and values rule firm at 10s. to 10s. 3d. for bests and specials, with other descriptions at from 9s. to 9s. 6d. Durham steam fuel is marked at 16s. 6d. to 18s. for large and 12s. to 12s. 6d. for smalls. Best gas coal is moving away briskly at 16s. 9d., and there are only odd turns to fill for a week or more ahead. Second kinds of gas coal are still only a moderate trade at 15s. 6d. to 16s. In the bunkering coal trade there are satisfactory clearances of bests and superiors, which range from 16s. 6d. to 17s. 3d. Second bunkers at 15s. 6d. to 16s. are quiet with an easy trend. There is no expansion pending in the coking coal business. Unscreened makes are obtainable at 16s. to 16s. 6d., and smalls at 15s. 6d. to 15s. 9d., but the inquiry lags. The coke trade maintains a very firm tone. Gas coke, whilst well sold ahead, is not in any brisk demand for prompt delivery owing to seasonal influences, but the autumn prospects are bright, and prices hold steadily at 21s. 6d. Patent oven cokes are steady, and in short supply for this month. Inquiries continue numerous, and the outlook is encouraging. Patent oven cokes are 23s. to 24s.; superior grades, 26s. to 28s.; beehive, 28s. to 32s.

Coal Miners' Wages.

Notwithstanding the fact that the shipments of Northumberland coal have been considerably augmented, the economic position of the industry in the county is still disappointing. The joint report of the accountants shows that the proceeds and costs in June, which would determine wages in August if the miners had not the protection of the minimum clause in the county agreement, would provide for 19·04 per cent. on the basis. This compares with 27·10 per cent. in July, and thus shows a fall of 8·06 per cent. due in a measure, no doubt, to old contracts at low prices still running. The minimum percentage on the basis is 40, and therefore the deficiency to be made up by the owners in terms of the agreement is 20·96 per cent. In Durham, also, there is a fall in the percentage, but not to the same extent as in Northumberland. The miners' wages in Durham in August would be 41·13 per cent. on the basis, as against 43·21 per cent. in July, a reduction of 2·08 per cent. The county minimum percentage to basis wages is 65, and thus the deficiency to be made up by the owners is 23·87 per cent.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

During the month of July thirteen vessels of 38,374 tons aggregate were launched from Clyde shipyards, bringing the total for the past seven months up to 132 vessels of 323,939 tons aggregate, figures which compare very favourably with those for the same period in previous years. Of the vessels launched during July, four were over 5000 tons each and were as follows:—"Llangibby Castle," a twin-screw motor ship, 12,150 tons, built for the Union Castle Mail Steamship Company, Ltd., London; the "Athelviscount," a twin-screw motor tanker, 9000 tons, for the United Molasses Company, Ltd., of London; the "Siamese Prince," a twin-screw motor ship, 6624 tons, for the Rio Cape Line, Ltd., of London; and the "Beaufort," a steam tanker, 5070 tons, for the Biorn Biornstad Company, of Oslo. In all probability shipbuilders will have a fair amount of work on hand over the winter months, but the outlook is uncertain, as some difficulty is experienced in securing contracts at remunerative prices, and at the moment the output rate still exceeds that of keels laid down. Contracts announced during July include the following:—A twin-screw steamer, 330ft. in length, for the C.P.R.; a 500ft. motor tanker for Swedish owners; a steamer of 6000 tons deadweight carrying capacity, for Spanish owners; a twin-screw motor vessel of 452ft., for Alfred Holt and Co.; and two passenger and cargo steamers, each of 4000 tons, for the Cia Sud Americana de Valpores, of Valparaiso.

Steel.

Prospects in the steel trade are comparatively fair at present. The weakness in continental markets caused some mild consternation, but it is thought that the movement is only a temporary one, which will be followed by a sharp reaction at an early date. Steel tubes have not been so busy of late, owing to a fall in export demands; but producers are not at all apprehensive, as a considerable amount of business is still held. The sheet trade shows little change, the heavy descriptions being still rather neglected.

Iron.

Bar iron and re-rolled steel producers are not well placed, orders being mostly of the hand-to-mouth description. The former are unchanged in price, while the latter are still quoted in the vicinity of £8 per ton home and £7 15s. per ton export. Pig iron is dull generally, but the recently established basis of prices is still upheld.

Scrap.

Supplies of scrap materials are still rather short and prices are firmly maintained round about 76s. 6d. per ton for heavy steel and 70s. per ton for cast iron machinery scrap.

Coal.

So far as the shipping market is concerned a better tone is apparent owing partly to a more regular supply of steamers at the loading stations. Most descriptions of round fuel, and especially Lanarkshire splints and Fifeshire prime steams, which are fully sold for this month, are quickly disposed of for prompt sale. Neither the collieries nor exporters are disposed to do business beyond this month, in view of the possible effects of Government intervention in the industry. Aggregate shipments for the past week amounted to 238,049 tons, against 211,258 in the preceding week and 205,307 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

It was not to be expected that there would be much, if any, activity in the coal trade this week, seeing that for the first three days there was no work at the pits, while on the docks the pitwood workers had holidays for the same period and coal shipments were suspended on Monday and Tuesday and only two short shifts were operated on the Wednesday. In the circumstances it will be next week before settled conditions will prevail. Colliery salesmen are holding their hand until they see what outputs are like, so as to gauge what they will have to sell. It is possible that some of them will still be able to do with spot orders for large coals, but as regards other qualities there is no question that they will be scarce for some little time. The tonnage position immediately before the vacation was slightly better than was anticipated, and on Saturday last there were twenty-eight idle tipping appliances at the various docks, while five steamers were waiting to load. Doubtless the exodus of tonnage just before the holidays will be compensated for by the arrivals of steamers during the week-end, and most collieries should have a fair supply of tonnage at their disposal. As a matter of fact, it is just possible that collieries will have a better time this month than last, notwithstanding that business for prompt loading has fallen off, and conditions are quiet. Returns show that the chartering of tonnage for loading during the next few weeks has been on quite a satisfactory scale. Shipments for the week ended the 2nd inst. were comparatively good, as the total quantity was nearly 580,000 tons, as against just over 553,000 tons; but the figures for the current week will be much reduced on account of the holidays. Business ahead is on the quiet side, but apart from the inquiry from the Paris-Orleans Railway for 5000 tons per month for delivery over 1930 it is reported that contracts have been made lately with foreign depôt owners for the supply of Welsh coals over next year on the basis of 19s. per ton f.o.b. for ordinary Admiralty large, 17s. 9d. for ordinary dry large, and 13s. for small coals, these sales being with the usual condition that protects sellers should there be any alteration in coalfield conditions as the result of Government intervention.

Pulverised Fuel as Bunkers.

Considerable interest was taken in the ss. "West Alsek," which left Cardiff at the end of last week for America after taking on board 350 tons of Powell Duffryn Ely Valley small and 350 tons of Princess Royal Forest of Dean small for pulverising and use as bunkers. The vessel has previously come from America to Glasgow on pulverised American coal and from Glasgow to Avonmouth on Scotch coal. The result of the experience gained with the different grades of coal will be awaited with much interest. During the steamer's stay at Cardiff a party of visitors, including a large number of engineers and fuel experts, inspected the pulverising plant at the invitation of the United States Shipping Board Merchant Fleet Corporation, and Mr. Carl Jefferson, head of the Fuel Conservation Committee of the Board, pointed out the economies that had been achieved since the vessel had been converted to a pulverised fuel burner. He stated that it enabled the rate of combustion to be better maintained and made it possible to use low grades of fuel with good results. The steamer made 1¼ knots more on the passage from America to Glasgow than was done on ordinary coal, and the coal cost 5s. per ton less than before. Considerable saving in coal consumption was made while general efficiency was considerably improved.

Tin-plate Trade Wages.

The first ascertainment under the new Welsh tin-plate sliding scale scheme, which is arrived at after taking into consideration the selling prices of tin-plate and leaving out the cost of steel bars and tin, has just been obtained, but no details or figures are being made public. All that is known is that the figure reached by the ascertainment was zero and wages consequently will remain unaltered for the next quarter. It will not be possible to tell how the new scheme is working as compared with the old until further ascertainments have been obtained.

Current Business.

The tone of the market all round is quiet and the conditions generally are affected by the holidays. Prices of all grades are for the most part nominal, but patent fuel is very steady, as stems are well filled, while pitwood remains unchanged.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Guest and Chrimes, Ltd., advise us that a silver medal for water fittings was awarded to them by the Royal Sanitary Institute at its congress and exhibition held in Sheffield recently.

Thos. W. Ward, Ltd., Sheffield, asks us to announce that it has acquired the Lowe and Worthington Cotton Spinning Mills, belonging to the Hindley Twist Company (1920), Ltd., Hindley, near Wigan, and will proceed to dismantle the plant at once.

LAUNCHES AND TRIAL TRIPS.

Penrith Castle, twin-screw motor vessel; built by Cammell Laird and Co., Ltd., to the order of the Lancashire Shipping Company. Engines constructed by North-Eastern Marine Engineering Company; trial trip, recently.

Kosmos, whaling factory ship; built by Workman, Clark (1928), Ltd., to the order of the Kosmos Whaling Company; dimensions, 570ft. by 77ft. by 50¼ft.; about 32,000 tons displacement. Engines, quadruple-expansion, pressure 250 lb. per square inch; constructed by the builders; trial trip, July 30th.

Thomas Holt, steamship; built by Cammell Laird and Co., Ltd., to the order of John Holt and Co. (Liverpool), Ltd.; dimensions, 330ft. by 47ft. by 28ft.; to carry cargo. Engines constructed by the builders; trial trip, July 31st.

CATALOGUES.

Croydon Cable Works, Ltd., Mitcham-road, Croydon.—Price list of cables.

Hunt and Mitton, Ltd., Oozells-street North, Birmingham.—A booklet on the "F" type patent mechanical lubricator.

Sanders and Forster, Ltd., Thames Works, Hertford-road, Barking, Essex.—A booklet of tables for the guidance of users of structural steelwork.

Concrete Mixers, Ltd., 27, St. James'-square, S.W. 1.—A pamphlet describing a concrete mixer made by Markham and Co., Ltd., of Chesterfield.

Thos. W. Ward, Ltd., Albion Works, Sheffield.—Catalogue 1013, June, 1929, a 430-page booklet giving a list of new and second-hand machinery in stock.

J. H. Sankey and Son, Ltd., Essex Wharf, Canning Town, E. 16.—A twenty-four-age booklet giving facts, figures and particulars of "Pyruma" fire cement.

White-Hall Boiler Bridge Company, 35 and 36, St. Thomas-street Lymington, Hants.—A leaflet giving particulars of the "White-Hall" smoke-consuming boiler bridge.

G. A. Harvey and Co. (London), Ltd., Woolwich-road, S.E. 7.—Catalogue No. 444 of "Harco" products, which include tanks, cisterns, ventilators, gratings, wire work, steel cupboards, racks, bins, &c.

Buck and Hickman, Ltd., 2, 4 and 6, Whitechapel-road, E. 1.—"The Brown and Sharpe Small Tool Catalogue, No. 31A," a 260-page booklet illustrating, describing, and giving prices of various small tools.

Crossley Brothers, Ltd., Openshaw, Manchester.—A pamphlet giving the history of the firm from 1866–1929; also Publication No. 1275 on producer gas plants using wood and vegetable refuse fuels.

Marshall, Sons and Co., Ltd., Gainsborough.—Publication 1888, Marshall return-tube and dry-back boilers of the "Economic" type. Publication 1976, Marshall "Britannia" vertical water-tube boilers.

English Electric Company, Ltd., Queen's House, Kingsway, London, W.C. 2.—Publication No. 947 on "Oil-immersed Circuit Breakers," Class O.K.D.I. Leaflet, concerning Bradford works and how to get there.

B.E.N. Patents, Ltd., 92, Tottenham Court-road, W. 1.—"'B.E.N.' Air Units," describing the firm's range of air compressors and a catalogue dealing with "B.E.N." mechanical rubbers and polishers for coachwork.

Great Western Railway, Chief Goods Manager's Office, Paddington Station, W. 2.—A book, "How to Send and How to Save," giving particulars of season tickets, rates and charges, railhead distribution, &c., on the G.W.R.

Woodhall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd., 136, Victoria-street, S.W. 1.—An illustrated brochure dealing in some detail with the Woodall-Duckham system of continuous carbonisation in vertical retorts.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	19/6 to 22/–
(1) Spanish	24/–
(1) N. African	24/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	24/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 15 6	3 15 6
No. 1	3 16 0	3 16 0
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
Midlands—		
(2) Staffs.—	(*Delivered to Station*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
,, ,, Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 12 6	—
Forge	3 8 6	—
(1) Derbyshire—		
No. 3 Foundry	3 16 0	—
Forge	3 12 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 5 6 (*a*) / 4 7 6 (*b*) / 4 11 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 0 0 to 11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 0 0
,, ,, (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 7 6
Sheets (Gal. Cor. 24 B.G.)	13 17 6	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 2 6	—
,, (Small Round)	8 5 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	9 17 6	—
Sheffield—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	8 10 0	—
Midlands—		
Small Rolled Bars	8 0 0 to 8 15 0	—
Billets and Sheet Bars	6 10 0 to 6 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 12 6	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/1½ to 18/6
Block Tin (cash)	213 12 6
,, ,, (three months)	217 7 6
Copper (cash)	73 5 0
,, (three months)	73 15 0
Spanish Lead (cash)	23 0 0
,, ,, (three months)	23 2 6
Spelter (cash)	25 3 9
,, (three months)	25 6 3
Manchester—	
Copper, Best Selected Ingots	78 10 0
,, Electrolytic	85 0 0
,, Strong Sheets	110 0 0
,, Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
,, Condenser, lb.	0 1 3
Lead, English	24 17 6
,, Foreign	23 10 0
Spelter	25 7 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/6½ per lb.	
Ferro Tungsten	3/3½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	7/6
,, ,, 6 p.c. to 8 p.c.	£23 0 0	7/–
,, ,, 8 p.c. to 10 p.c.	£23 0 0	6/6
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£34 0 0	12/–
,, ,, ,, 1 p.c. carbon	£38 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£42 0 0	17/–
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
FerroManganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£19 10 0 scale 6/– per unit	
,, Vanadium	13/– per lb.	
,, Molybdenum	4/– per lb.	
,, Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire	
(f.o.b. Glasgow)—Steam	13/6
,, ,, Ell	14/6
,, ,, Splint	15/9 to 17/–
,, ,, Trebles	15/6 to 16/–
,, ,, Doubles	14/6 to 15/–
,, ,, Singles	12/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	16/6
,, ,, Trebles	15/–
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	12/– to 13/–
Screened Navigation	17/6 to 18/6
Trebles	16/– to 17/–
Doubles	14/6 to 15/–
Singles	12/9
Lothians—	
(f.o.b. Leith)—Best Steam	14/–
Secondary Steam	13/6
Trebles	15/6
Doubles	14/6
Singles	13/–

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		24/– to 25/–
Household		38/– to 51/–
Coke		26/– to 26/6
Northumberland—		
Best Steams		14/6 to 15/–
Second Steams		13/9 to 14/–
Steam Smalls		9/6 to 10/6
Unscreened		13/– to 13/6
Household		21/– to 26/–
Durham—		
Best Gas		16/6 to 16/9
Second		16/– to 16/6
Household		21/– to 27/–
Foundry Coke		22/– to 28/–
Sheffield—	Inland.	
Best Hand-picked Branch	25/6 to 26/6	—
Derbyshire Best Bright House	19/– to 21/–	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	17/6 to 18/6	—
,, ,, Nuts	15/6 to 16/6	—
Yorkshire Hards	15/– to 16/–	—
Derbyshire Hards	15/– to 16/–	—
Rough Slacks	9/– to 10/–	—
Nutty Slacks	7/– to 8/–	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		21/6 to 22/6

(9) SOUTH WALES.

	Export.
Cardiff—	
Steam Coals:	
Best Smokeless Large	19/9 to 20/–
Second Smokeless Large	19/6 to 19/9
Best Dry Large	18/9 to 19/–
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/– to 18/3
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/9 to 14/6
Ordinary Smalls	12/6 to 13/–
Washed Nuts	20/– to 23/6
No. 3 Rhondda Large	20/– to 21/–
,, ,, Smalls	15/6 to 16/–
No. 2 ,, Large	17/– to 17/6
,, ,, Through	15/6 to 16/6
,, ,, Smalls	13/6 to 14/–
Foundry Coke (Export)	26/6 to 36/6
Furnace Coke (Export)	21/– to 23/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	32/– to 33/–
Swansea—	
Anthracite Coals:	
Best Big Vein Large	33/– to 36/6
Seconds	27/6 to 30/–
Red Vein	23/– to 27/–
Machine-made Cobbles	40/– to 44/–
Nuts	40/– to 44/–
Beans	23/6 to 25/6
Peas	18/– to 19/–
Breaker Duff	9/– to 9/6
Rubbly Culm	10/3 to 10/9
Steam Coals:	
Large	18/– to 19/–
Seconds	17/– to 18/–
Smalls	11/3 to 13/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum) 12/6

Ordinary Ship, Bridge and Tank Plates and Sections 10/– if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Naval Armaments.

THE negotiations for a reduction of naval armaments are being closely watched in this country with a certain anxiety, for the ideas prevailing here do not coincide with those of the two naval Powers which have taken the initiative for a further limitation. The French are quite at one with the British so far as concerns the necessity of possessing a fleet specially adapted to home and colonial defence. But they are unable to get over the feeling that they were badly treated at the Washington Conference, and having now made good headway with the reconstitution of their navy and created a national sentiment against allowing anything to undermine the naval power, it is certain that any scheme for a further reduction of naval armaments will be resisted unless it is accompanied by a general disarmament and measures are taken to insure absolute security. The French naval sentiment was never stronger than it is now. Apart from the question of home and colonial defence, a powerful navy is regarded as essential to the country's standing abroad, and, without it, the shipyards would be in a far worse position than they are now. Any proposal to abandon submarines would meet with uncompromising resistance.

Export Prices.

The heavy decline in the foreign demand for iron and steel is largely of a seasonable character, but that does not explain entirely the importance of the contraction, which is accompanied by a continuous fall in prices. The situation is worse in Belgium, where producers are far more dependent upon a foreign trade, and while it is spoken of as critical, it does not alarm iron and steel makers, who believe that the setback is temporary. Nevertheless, there is an impression that a permanent crisis can only be averted by the maintenance of the Steel Cartel, and the forthcoming meeting in Vienna to examine the conditions under which the Cartel can be renewed, will, therefore, decide the fate of the steel trade. In view of the increasing exports from the United States, particularly of thin planished sheets for the motor car industry, continental producers are more than ever convinced of the necessity of combining in defence of their own markets, and it is therefore almost certain that the Cartel will be renewed, even at the expense of giving in to the claim of Germany for a larger quota. In France there is not the same evidence of weakness, except in heavy structural steelwork, and prices on the home market continue to harden.

European Ports.

The Commission appointed by the Association des Grands Ports Français to visit various ports at home and abroad has completed its journey, during which it appears to have acquired valuable experience that will enable it to prepare a programme for the reorganisation and more rational equipment of the French ports. The members were greatly impressed with the development of the ports of Rotterdam, Amsterdam, Hamburg and Antwerp. At Hamburg they saw floating docks under construction at the Vulkan yards for Havre and Rouen, and a powerful dredger for Bordeaux. The French visitors were accorded a good reception, the authorities offering them every facility for seeing what had been accomplished at the port of Hamburg, and much was said about the international character of the great ports and the necessity of co-operation. The Germans did not fail to impress upon their visitors the remarkable progress of Hamburg, which now receives a tonnage of shipping 50 per cent. more than before the war. Important works have also been carried out at Antwerp, notably the construction of new dry docks, and the diversion of traffic from Alsace since the war has necessitated the construction of vast warehouses for the potash which is now shipped through that port. It is intended to create a great manufacturing centre by making new docks with facilities for erecting factories around them. While the Commission will prepare the general lines for the reorganisation of the French ports, the Government has already given some satisfaction to shipbuilders and owners by enlarging the scope of the financial organisation known as the Crédit Maritime, particularly in suppressing the tax on turnover on everything relating to the construction and repairing of ships and in granting a larger bonus in the case of cargo boats to compensate for any increased difference between French and foreign costs.

Trade Returns.

Notwithstanding a slight improvement in June as compared with the previous month, the returns of foreign trade for the first half of the year are far from satisfactory. The values of imports were estimated at 30,640 million francs, an increase of 4453 millions as compared with the first six months of 1928. The exports totalled 24,727 million francs, a decline of 511 million francs. The "balance of trade" showed a deficit of 5912 million francs, as against 948 million francs a year ago. The quantity of imports was 28,611,556 tons, an increase of 4,738,525 tons, and of exports 19,308,582 tons, a decline of 930,735 tons. The difference between the values and quantities of manufactured goods increases every month. While the imports of manufactured goods totalled 1,010,871 tons, an increase of 371,152 tons, the values increased by more than 1223 million francs, but the exports of manufactured goods, which reached 2,552,708 tons, an augmentation of 60,038 tons, declined in value by 236 million francs. There is, of course, the same explanation that this country is taking larger quantities of machinery and other goods from Germany on account of reparations at higher values, while the French have to accept less for what they sell abroad. The same thing may be said of raw material, the imports of which largely increased, but as raw material imports totalled 18,844 million francs and the exports of manufactured goods reached 15,370 million francs, the situation is not so bad as it seems.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

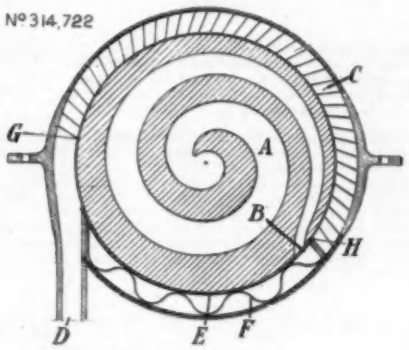
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

314,722. Spetmber 11th, 1928.—A REACTION GAS TURBINE, H. Strauscheid, Frendenberg, Kreis Siegen, Germany.

In this gas turbine the combustible mixture is ignited by means of a sparking plug in the spiral passage A. It is introduced through a hollow gudgeon. The products of combustion escape by the orifice B, and by their reaction drive the rotor.

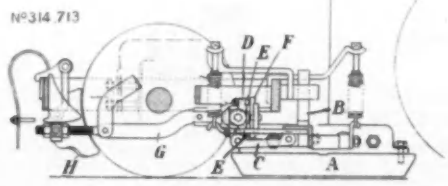


They are entrapped in the chambers C, whence they escape to the exhaust pipe D through the clearance between the rotor and the stator. E is a plate which is held up against the periphery of the rotor by the sinuous spring F. Admission of the combustible mixture starts at G, and its ignition takes place at H.—*July 4th*, 1929.

TRAMWAYS AND RAILWAYS.

314,713. August 14th, 1928.—BRAKE SYSTEMS FOR TRAMCARS, A. W. Maley, 4, Grosvenor-road, Handsworth, Birmingham, and E. M. Taunton, 11, Wilton-road, Handsworth.

The object of this invention is to utilise the drag of a magnetic rail brake for the application of another brake on the pony wheel to the utmost possible extent. The magnetic brake is

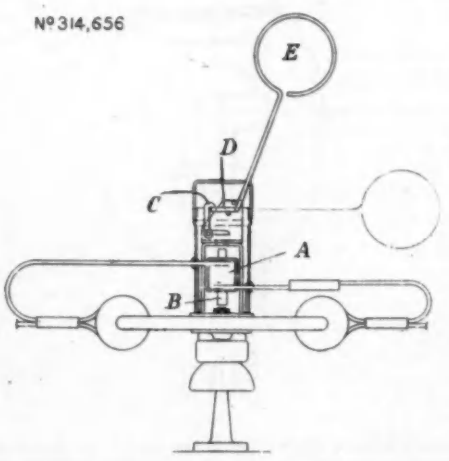


shown at A, and is of normal type. It is anchored, within limits, by the vertical stop B, and is also attached, by the link C, to the rocking lever D. This lever has two pads E E, which bear against the plate F on the drag link G of the pony wheel brake H. Whichever way the magnetic shoe tends to move, when it is applied to the rail, it actuates the wheel brake.—*July 4th*, 1929.

TRANSMISSION OF POWER.

314,656. June 1st, 1928.—FAULT INDICATORS FOR OVERHEAD TRANSMISSION LINES, Gordon Cluley, of "Vesteras," Finghall-road, Urmston, Lancaster, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

When an abnormal current passes through the coil A, the



armature B is raised and releases the claw C, thus tripping the arm D and allowing the flag E to drop to the horizontal position. Fault-indicating devices of this nature may be included in overhead transmission lines at various points, and particularly where branch connections are made to the main line, and in branch connections themselves, so that when a fault occurs at any part of a line, a linesman may examine the various fault indicating devices, and so ascertain the point at which a fault has occurred.—*July 4th*, 1929.

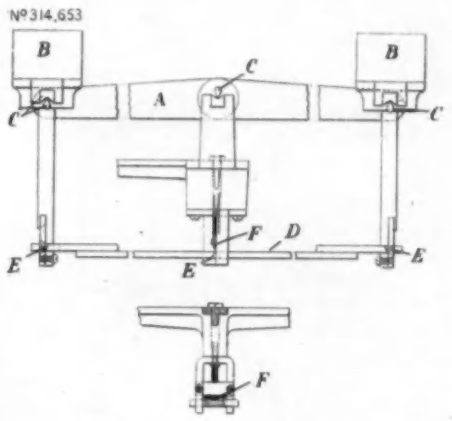
314,708. August 8th, 1928.—HOBS FOR CUTTING GEAR WHEELS, David Brown and Sons (Huddersfield), Ltd., Lockwood, Huddersfield.

The object of this invention is to provide a hob for cutting the teeth of worm wheels which will continue to produce accurately shaped teeth during a long period of wear. In the specification it is explained that the hob consists of two portions, which may be integral, or the hob may be built up of two or more sections. In either case the leading teeth of the hob correspond to those of an ordinary hob, and are formed by relieving gashes out approximately at right angles to the threads of the hob, to provide cutting edges. The leading teeth may also be tapered in the known way to increase the cutting capacity of the hob when feed is applied in the direction of the axis of the hob. The roughing teeth formed as above are followed by a section or sections of the hob formed with fine-pitched cutting edges or serrations. These serrations are cut in the flanks of the threads of the hob, which are left unrelieved for this purpose. Two or more fine-pitched sections differing in the degree of their fineness may be provided. In use, the coarse-pitched teeth effect the roughing-out of the teeth of the worm wheel, and are followed by the fine-pitched finishing teeth. The actions of cutting and finishing overlap to a certain extent, and reduce the time which would be required to achieve the same result by two separate tools and operations. The large number of fine pitched teeth, in conjunction with the small amount of metal left to be removed by them, makes wear of the cutting edges very small, so that the correct form is maintained on the wheel teeth produced. The roughing teeth can be sharpened in the usual way by grinding back the front faces with an abrasive wheel.—*July 4th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

314,653. June 1st, 1928.—WEIGHING APPARATUS, W. and T. Avery, Soho Foundry, Birmingham.

The inventors state that there is a liability for the knife edges of a balance of the Roberval type to get out of place, and consequently affect the accuracy of the instrument. In the drawing

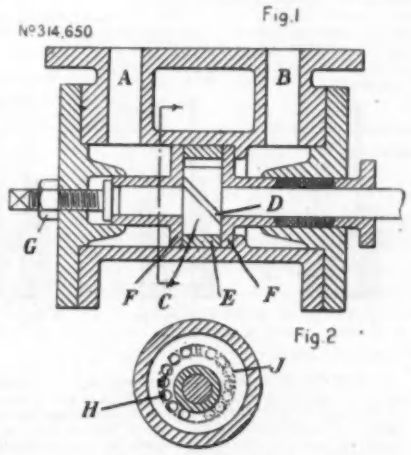


the balance lever is shown at A, the scale pan supports at B B, and the main knife edges at C C C. The bottom link D of the parallel motion is given a slight permanent set, but is forced down against its springiness, so that the knife edges E E E are in line, by a secondary, screw-controlled knife edge F. The internal force thus produced in the linkage keeps the knife edges in position.—*July 4th*, 1929.

PUMPING AND BLOWING MACHINERY.

314,650. May 26th, 1928.—AXIAL ROTARY PUMPS, J. G. McKean, Westerhill, Mount Vernon, Lanarkshire, and R. F. Jones, 11, Leven-street, Pollakshields, Glasgow.

This pump is a modification of the familiar radial vane rotary



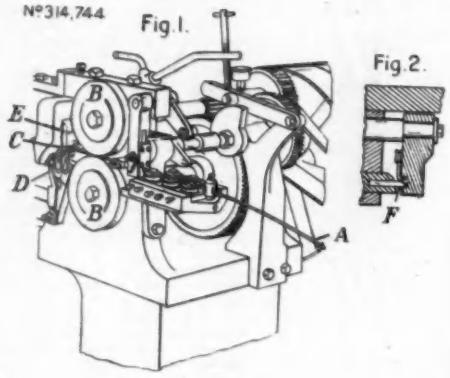
type. In it the flow is axial, from the inlet A to the outlet B. The rotor is, of course, excentric, and is shown at C. It is provided with diagonal blades, one of which is shown at D. It

rotates within a renewable ring E and end plates F F. An adjustment G is provided for setting the end clearance. In Fig. 2 the inlet ports are shown at H and the outlets at J.—*July 4th*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

314,744. April 23rd, 1928.—Cutting Mechanism for Wire Spring Making Machines, C. H. Ziller, 206, Grant-street, Carthage, Missouri, U.S.A.

This is one of several associated specifications, and is concerned with that type of machine used for coiling upholstery springs by pushing a wire between a set of bending rolls. The object aimed at in this case is to cut off the wire from the stock,

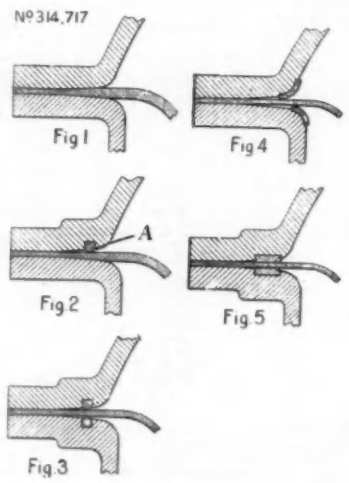


and, at the same time, bend over the end to facilitate its fastening. The wire A is fed forward by the rolls B B, and is coiled up by the forming rolls C as shown at D. The cutting-off mechanism E is best shown in Fig. 2. It will be seen that the cutter F has a bevelled back edge, and that it coacts with a recessed die. The consequence is that as the wire is cut off the end is bent over by the back of the cutter.—*July 4th*, 1929.

MISCELLANEOUS.

314,717. August 29th, 1928.—Gas Meter Diaphragm, F. Thorp, Victory Works, Stretford, Manchester.

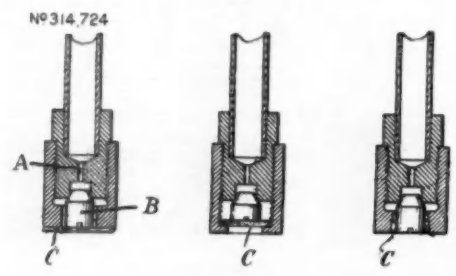
It is explained that the diaphragm of a dry gas meter is liable to failure through continued flexure at the point where it emerges from the clamping flanges. The inventor consequently suggests



several means of alleviation. In Fig. 1 the clamping is effected only at the outer edge of the flange, and the inner edges of the flange are rounded. In Fig. 2 an annular wick impregnated with lubricant or dressing is introduced at A, or two wicks may be provided as shown in Fig. 3. Figs. 4 and 5 indicate alternative arrangements of leather pads for the same purpose.—*July 4th*, 1929.

314,724. September 13th, 1928.—Fire Extinguishing Sprinklers, R. A. Blakeborough and J. Black, Woodhouse Works, Brighouse, Yorks.

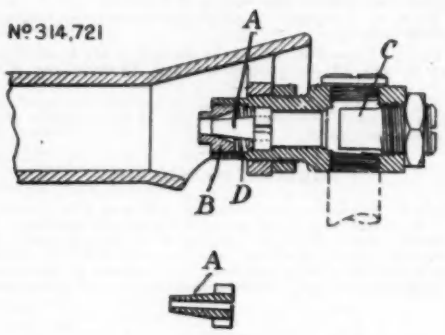
The inventors suggest that if carbon-tetra-chloride is used as a fire-extinguishing medium, it should be discharged as a solid



jet. So they do not employ what is commonly recognised as a sprinkler, but rather a plain orifice A. This orifice is closed by a plug B, which is held in place by fusible metal, as indicated in alternative arrangements at C C C. It will be observed that when the metal fuses and the plug is discharged, there is a clear passageway for the extinguishing liquid.—*July 4th*, 1929.

314,721. September 7th, 1928.—Gas Burners, I. Turner, 19, Warren-avenue, Richmond, Surrey.

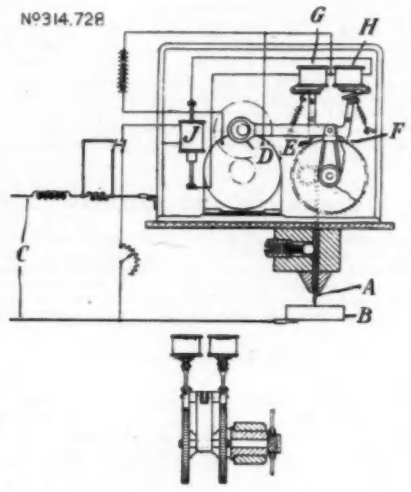
This invention is concerned with the adjustment of the jet or nozzle of atmospheric gas burners. The jet A has a central bore, and a flange at the rear through which there are cut several slots. In front of the jet there is a conical nozzle B, which may be screwed in and out of the casing. Gas passes both through the



central bore and through the slots to issue by the annular space between the jet A and the nozzle B. The amount of this opening is determined by the position of the nozzle. The plug C provides for the rough regulation of the flow of gas. The jet is held in place by the spring D.—*July 4th*, 1929.

314,728. September 18th, 1928.—Arc Welding Apparatus, Associated Electrical Industries, Ltd., Bush House, Aldwych, London, W.C. 2.

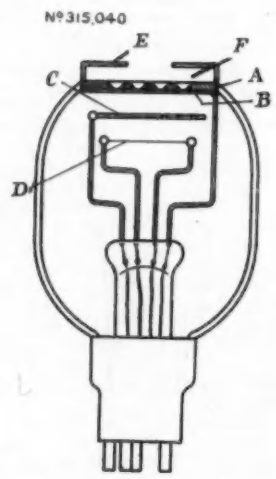
In this apparatus an effort is made to regulate the feed of the electrode according to the progress of the work. The wire electrode is shown at A and the workpiece at B. The arc is provided by the circuit C in a normal manner. Within the welding head there is an electric motor, which, by means of the excentric gear D and the ratchet pawls E and F, feeds the wire



electrode. These two pawls are also connected with the electromagnets G and H, which are in circuit with the relay J that responds to the voltage in the arc circuit. The arrangement is such that when the voltage is high the feeding forward pawl is engaged, while when the voltage drops the other pawl, which retracts the wire electrode, comes into action. It is stated that the feeding action is at the rate of $\frac{1}{8}$ in. in the twelfth of a second, and that the range of voltage is between 15 and 14 volts.—*July 4th*, 1929.

315,040. May 4th, 1928.—Electro Acoustic Converter, Bertram Sydney Cohen, of 9, Lebanon Park, Twickenham.

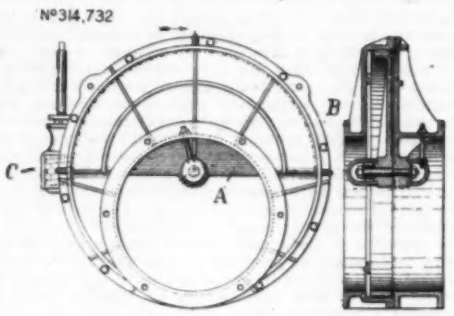
The electro acoustic converter described in this specification is of the type that makes use of the heating effect of an electric current to produce pressure waves in the sound transmitting medium. The object is to construct the elements converting heat energy into sound energy as integral parts of a thermionic



valve which amplifies the electrical energy and also converts the energy into sound. The valve is provided with a perforated non-conducting plate A to which a thin sheet of platinum B is attached and which acts as the anode, C being the grid and D the cathode. An enclosure E with an opening is arranged over the plate A to form an air chamber. The area of the perforations in the plate A and the thickness of the metal sheet B are arranged so that a maximum thermal effect may be obtained at the exposed part of the metal when the valve is in use. The device, therefore, constitutes a thermionic thermophone.—*July 11th*, 1929.

314,732. September 27th, 1928.—Valves for Gas Mains, W. W. Skidmore-Westwood, West-hill, Hagley-road, Stourbridge.

The inventor says that there is a tendency for the valves used to control coal gas mains to become so corroded that they leak. His valve takes the form of a half disc A—it is described in the



specification as a disc—in the circular casing B. The half disc is continued by a hoop-like extension to complete the circle, and is provided with four wedge-shaped lugs to press the valve on to its seating when it is closed. The valve is operated by the worm gear C, which meshes with teeth cut round its periphery. Arrangements are provided for keeping the moving parts well supplied with grease.—*July 4th*, 1929.

Forthcoming Engagements.

Secretaries, of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND TILL TUESDAY, AUGUST 13TH.

Institution of Electrical Engineers: London Students' Section.—Summer Tour, 1929. The tour is this year being held in Paris and Northern France.

MONDAY TO SUNDAY, SEPTEMBER 9TH TO 15TH.

Institute of Metals.—Annual autumn meeting. Düsseldorf, Germany. Monday, September 9th, in the Aula of the Lessing Oberrealschule, Ellerstrasse, Düsseldorf, 5 p.m. Eighth autumn lecture, by Dr. A. G. C. Gwyer, B.Sc., "Aluminium and its Alloys." Tuesday, September 10th, 9.30 a.m., in the Hall of the Eisenhüttenhaus, Verein Deutscher Eisenhüttenleute, 27, Breitstr., Düsseldorf. Reading and discussion of paper (see page 66, July 19th, 1929). Wednesday, September 11th, 9.30 a.m., in the Hall of the Eisenhüttenhaus, Verein Deutscher Eisenhüttenleute, 27, Breitstr., Düsseldorf. Reading and discussion of paper (see page 66, July 19th, 1929). Thursday, September 12th, 8.15 a.m., whole-day excursion to Messrs. Krupp, Essen. Friday, September 13th, to Sunday, September 15th, visits to Berlin and Holland.

TUESDAY TO FRIDAY, SEPTEMBER 10TH TO 13TH.

Iron and Steel Institute.—Autumn meeting at Newcastle-on-Tyne.

THURSDAY TO SATURDAY, SEPTEMBER 12TH TO 28TH.

Shipping, Engineering and Machinery Exhibition, Olympia.

SATURDAY TO SATURDAY, SEPTEMBER 14TH TO 28TH.

Institution of Naval Architects.—Summer meeting in Italy. For programme see page 380, April 5th, 1929.

CONTRACTS.

Birmingham Electric Furnaces, Ltd., informs us that it has received an order from Chas. Clifford and Son, Ltd., Fazeley-street Mills, Birmingham, for an electric furnace having a usable hearth 7ft. long by 3ft. 9in. wide with a maximum rating of approximately 120 kW for brass annealing. This furnace will be supplied with "Birlec" three-arm electrically-driven charging machine and trolleys.

The English Electric Company has received from the Nottingham Corporation an order for twenty double-deck, top-covered omnibus bodies. The bodies will be mounted on chassis of the Associated Equipment Company's manufacture, the chassis being of the four-wheel type. Each vehicle will have seating accommodation for fifty-one passengers. Fifteen of them are to have standard rear entrances, and five of them central entrances.

Henry Simon, Ltd., of Manchester, has received an order from the Liverpool Electricity Department for the mechanical coal discharging plant required in connection with the new power station which is being built at the Clarence Dock, Liverpool. The plant will have a handling capacity of 440 tons of coal per hour, and will include belt conveyors for transferring coal from receiving bunkers below railway tracks to the storage bunkers in the boiler-house. The order also includes all the necessary structural steel work and the electrical equipment for the coal discharging plant in addition to the installation of the mechanical conveyors. The same firm has also secured an order for two 70-ton pneumatic coal handling plants from the New South Wales Electric Tramways and Light Company, Sydney.

R.I.B.A. Maintenance Scholarships in Architecture.—The Board of Architectural Education of the Royal Institute of British Architects announces that R.I.B.A. Maintenance Scholarships of £100 have been awarded to Hubert Bennett, of Swinton, Manchester, and F. W. Wright, of Sheffield. The scholarships are tenable in the first instance for one year and are renewable for two further periods of one year each. The R.I.B.A. Maintenance Scholarship of £50 awarded to A. K. Brown, of Sunderland, has been continued for another year.